Digital Family Portraits:
Support for Aging in Place

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Digital Family Portraits:
Support for Aging in Place

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SUMMARY

Not only is the population of the world growing, the demographics of that population are changing. The numbers of people surviving to retirement age and beyond to old-old age is increasing at an even greater rate, placing an ever increasing strain on the social institutions intended to support this aging population. Simply put, how does society cope with an increasingly aged population? My approach to this question involved a series of studies to first determine the nature of aging and then to identify problems that are addressable through technological means.

While there is an overwhelming desire to remain in the familiar surroundings of the family home, what is called Aging in Place, the inevitable changes that occur in their lives as they age force the aging adults and their families to consider a move to some form of institutional living. The death of a spouse stands out as one predominant changes that forces such a consideration. As I found while conducting a number of interviews (detailed later) this move is frequently initiated not by the aging parent themselves, but by the adult child in an attempt to maintain peace of mind concerning the well-being of their parent. For this research peace of mind for the adult child is a state of mind that comes from knowing enough about the day to day affairs of the aging parent to feel comfortable with the decision to allow the aging parent to remain in their own home. No longer living near the aging parent, the adult child is deprived of the normal day-to-day opportunities to “keep an eye out” for changes in their parent’s well-being. While there may be no overwhelming need to move the parent to an institutional setting, the adult

child nevertheless suggests the move so that “at least some one” can keep tabs on their parent’s day-to-day well-being.

According to chaplains who counsel families making this transition, the move to institutional living is always accompanied with a “profound sense of loss” making it a less than desirable solution to a peace of mind problem.

I view this deficit in peace of mind as a social communication issue between the members of the extended family, a social communication issue that is the result of the distance that now divides those members. Rather than resolving this peace of mind issue by forcing a move to institutional living, I propose to address this problem by first proposing that technology can help minimize the anxieties experienced by the adult child concerning their aging parent’s well being by appropriately presenting information on the aging parent’s daily life. This technology does not require that the aging parent input, or for that matter, do anything other than live their lives as they normally live them. Further, this technology provides this information in a manner that is continuously available to the adult child for either opportunistic or planned perusal.

By first identifying peace of mind as an issue that threatens Aging in Place and then proposing the embedding of well-being related information in a framed photograph, I created the Digital Family Portrait, a single instance in the real world of the design concept presented above, and then feasibility tested it in an initial field trial as a Wizard of Oz simulation. The results of that initial field trial led to lab-based studies to address

issues of icon meaning, size discernment and gender assignment and then to a redesign of the Digital Family Portrait.

To test the acceptability and functionality of the newly redesigned Digital Family Portrait, I planned a long term field trial using sensors placed in the home of the aging parent to drive a Digital Family Portrait display in the home of the adult child. Evaluating the range of commercially available sensors and matching their capabilities to the requirements of this field trial, I chose a sensor for placement in the home. The perceived information needs of the adult child drove the sensor placement within the home. After I installed the sensors in the home, the collection of movement data inside the home began. During an 8 week intensive study period I conducted both pre- and post interviews, collected daily diary entries from both participants and collected Digital Family Portrait usage log data.

The result of this field trial was to find that the Digital Family Portrait was an acceptable means of resolving certain peace of mind issues for the adult child while not raising privacy concerns for the aging parent. It could be used to investigate issues of concern for the adult child while the information uncovered by this investigation was used in a socially acceptable manner. Finally, even though there was no visible evidence of the system in the aging parent's home, the knowledge that it was in place and that someone was "looking in" on them was sufficient to prompt the aging parent to report feeling "less lonely."

Although my primary evidence for the utility of the Digital Family Portrait is limited to this single, long-term field trial, the unique contribution of this research is that it has had considerable impact. My original CHI 2001 paper [MYN01] is well cited with cites by over 30 papers in the ACM library with Intel Research having modeled their CareNet display [CON04a] [CON04b] [ROE04a] [ROE04b] directly after the Digital Family Portrait. Additionally a Google search on the string "Digital Family Portrait Mynatt Rowan" yields greater than 250 hits. The activity data gathered from the field trial is currently fueling other Georgia Tech research in activity discovery [HAM05] as well as research in activity prediction at Intel/Berkeley. Finally, research at Georgia Tech and elsewhere is continuing to refine and deploy the Digital Family Portrait in both aging in place research and home-based chronic health care.

Contribution Summary

In my initial investigations into the aging in place I discovered that one serious threat is a lack of peace of mind on the part of the adult child. In response to this threat I designed the Digital Family Portrait. Early evaluation demonstrated initial acceptance of the design and suggested design changes which were first evaluated and then incorporated into the design, preparing it for a year-long field trial. Within the confines of this year-long field trial, the Digital Family Portrait is shown to be a socially acceptable means of providing an adult child with peace of mind through its persistent display as well as providing a means to investigate the adult child's questions of interest.

Further, this research has shown contributions beyond those directly attributable to the research itself. The Digital Family Portrait, through its very wide media coverage, has demonstrated societal impact in that it has been incorporated into radio, TV, World Wide Web and print media reporting. Refer to Table 9 for a partial listing of this coverage. The Digital Family Portrait, through the generation of a unique, real-life, gathered-in-situ data set, has had considerable impact on the research community in that the data set is being used as a test set against which various other research initiatives can be evaluated. Finally, the original publication [MYN01] of these efforts has been widely referenced by other researchers working in this domain.

CHAPTER 1

INTRODUCTION

1.1 Motivation

1.1.1 The Graying of America

In its report *Older Americans 2000: Key Indicators of Well-Being* [Agi05] the Federal Inter-Agency Forum on Aging Related Statistics states that as of the year 2000, there are 35 million people age 65 or older in the United States or 13% of the total population. This growth is clearly a significant increase in number and percentage from the previous century when there were only 3 million (3% of total population) people 65 years in age or older. By the year 2030, 1 in every 5 people will be 65 or older resulting in a staggering 70 million people in that age group.

Though the number of people over the age of 65 is indeed striking, it is not completely descriptive of the impact of the aging population on the population in general. Consider that by the year 2050 fully 5% of the population, some 19 million individuals, will be 85 or older, up from only 2% or 4 million in 2000. Not only is the number of people of retirement age increasing dramatically, the number of people surviving to old-old age (85 and above) is also dramatically increasing.

1.1.2 The Desire to Remain at Home

For more than just economic reasons, a primary goal of many older individuals is to maintain an independent lifestyle [Wil96]. Thus, many older adults live in private homes typically either alone or with family[Smi90]. From initial interviews of chaplains at the

Wesley Woods center, I discovered that even though there are benefits to living in an institutional setting most new residents reported a profound sense of loss. (For more detail about the nature of these interviews and the associated site visits refer to the excerpted text of those interviews found in Appendices A and B).

> "Moves to assisted living are rarely voluntary… Some feel liberated by the move to assisted living… Generally (there are) feelings of abandonment, fear, guilt and sadness."

My research addresses those who wish to remain in the family home, where the many benefits afforded by living in familiar surroundings outweigh the benefits that can be derived from institutional living.

1.1.3 Death of a spouse

Not only are people living longer but the numbers of people who will be facing one of the most traumatic and potentially life altering periods of their lives, the death of a spouse, will be increasing dramatically. The death of a spouse, one of the most profound personal losses experienced in one's life, is a critical time for the surviving spouse [Aar05]. It is a time when relatives become concerned about the well-being of the surviving spouse; a time when life altering decisions are considered and made.

The most current statistics estimate that women account for 58 percent of the population age 65 and older and 70 percent of the population age 85 and older. Of the women 85 or

older, about 77 percent of them were widowed while 42 percent of men had lost their spouse [Agi05]. Assuming this percentage holds, the projected 2050 population of individuals 85 and older who, having lost a spouse and therefore having to deal with the difficult decisions that arise under that circumstance, will number more than 13 million.

1.1.4 Distance

Gone are the days when it is commonplace for a person to live out their lives in a small geographic area. No longer can members of an extended family keep tabs on one another through the casual, occasional, daily contact that occurs while carrying out their normal daily pursuits. In today's economy, people fluidly change location in pursuit of better educational and job opportunities. It is not uncommon for the extended family to be spread out across a continent with aging parents living at some distance from their working children who struggle with how to care for this aging parent from a distance [She04].

The impact of geographic distance is reduced when there are two aging parents living together, since two people together can support one another during a difficult time of injury or illness. When this support network breaks down, as it would with the death of one of the parents, the adult children are suddenly faced with the realization that they have no way of keeping tabs on the surviving parent. Prior to the death of one of the parents, weekly contacts may have been sufficient to provide peace of mind since the adult children could expect any drastic changes in their parent's lives (such as illness or injury) to be reported by the unaffected parent. With just one aging parent living alone,

this week to week contact is no longer sufficient to provide peace of mind about the surviving parent's well-being since illness or injury could go unnoticed for a week. This transition drastically reduces peace of mind for the adult child.

Deprived of the casual day-to-day contact that would occur if they were co-located and deprived of the mutual support structure provided by a partner, the adult children are faced with a peace of mind crisis. The aging adult's desire to remain in the familiar setting of the family home frequently must be balanced with their extended family's desire to keep them safe. Clearly this balance becomes more precarious as age increases. An aging couple can support one another, but if one becomes incapacitated, can the other support himself? No longer can family members have the peace of mind that derives from knowing that one aging parent can support the other. Additionally geographic distance between extended family members exacerbates the problem by denying the casual daily contact that naturally occurs when families are co-located. In this research I address the anxieties that adult children experience when concerned about an aging parent living alone at a location that denies casual daily contact

1.2 Adult Children, Peace of Mind and Aging in Place

Coming from the site visits and interviews of staff, administration and chaplains that I conducted at the Wesley Woods Center was the observation on the part of the chaplains that when people move to a facility such as the Wesley Woods Center, it frequently was not originally their idea, rather it is an idea that is first broached by and then driven by

their adult children. From the earlier quote above we see that these moves are rarely voluntary, add to this that…

> "…the children are usually heavily involved in the decision to move to (Wesley Woods) in perhaps 50-70% of the entrances."

No longer living in close proximity to one another, the adult children of elder parents are deprived of the peace of mind necessary to be comfortable the decision to allow their elder parents to age in place. Given that distance deprives the adult children of the day to day contact necessary to keep an eye on their aging parents and that with the death of a spouse peace of mind about the day to day well-being of the surviving parent becomes a greater concern, how then can peace of mind be restored?

In one of the interview sessions of elder parents living alone in their own homes I happened upon the possibility of also interviewing the adult child in addition to the single, 90+ year old father. The interview of the adult child provides an excellent example of how this peace of mind is broken by the death of a spouse and the distance between the elder parent and the adult child.

> The adult child (who we will refer to as Tom) and his elder father (who we will refer to as Walt) live about an hour from one another. Walt lives by himself now, his wife having died a year earlier, in his own home in a rural area with no close neighbors. This home had just recently been

finished, the culmination of a life-long dream to move to this particular rural area and live rather than just visit occasionally. To feel comfortable about letting his father stay by himself under these conditions Tom and Walt worked out an arrangement. Walt was to call Tom at home or at work (depending on the day) at some time in the morning, just to check in and let Tom know things are fine. The problem with this plan was that Walt was over 90 and sometimes forgets to place the call. This by itself would not be so much of a problem except that Walt is also nearly deaf, making Tom's attempt to resolve the missed phone call by calling Walt untenable. There have been attempts to resolve this through the installation of blinking lights and even the installation of a very loud bell, none of which resolved the problem.

In the face of the missed morning phone call, Tom is faced with a dilemma. Does he just assume Walt is fine and has simply forgotten to call or does he get in his car and drive two hours, round trip to find out that, in all probability, Walt is just fine. Tom's peace of mind concerning Walt's well being has been damaged by the death of Walt's wife and by the distance that exists between Tom and Walt.

Also during this interview Tom pointed out that all he would need to know about Walt in order to avoid this 2 hour side trip would be to know whether or not Walt had gone out to the mailbox to get the morning mail. While this is a simple solution that is very specific

to this one family, it is indicative of the possibility of providing the needed peace of mind through very simple means. While this one example is not necessarily generalizable it does serve to point out that complex schemes with complicated sensing are not necessarily required to bring the peace of mind needed to solve the problem at hand.

1.3 Design Concept

The peace of mind that goes lacking in the adult child thus affecting the aging in place decision process is due to an interruption of the kind of natural social communication that occurs when people live in close proximity to one another. Picking up on the naturally occurring clues provided by the simple fact that people go about daily life in the same physical space gives them an opportunistically-gathered awareness and provides them with a sense of the other's day-to-day well-being.

In this research, I posit that technology can help minimize the anxieties of adult children by restoring information about the activities of daily life. Sensors in an instrumented home of an elder parent can monitor a portion of the continuous flow of activity and this information can be appropriately presented to the adult children. The elder parent need not explicitly provide information to the sensing system and the information can be continuously available to the adult children for opportunistic or planned perusal.

1.3.1 Sensing and Privacy

When viewed from the elder parent's side, sensing in the home can be seen as an invasion of privacy, yet the surviving parent's reluctance to change residence following

the death of a spouse makes them receptive to the idea of some sort of remote monitoring, especially if they have some prior personal familiarity with its possibilities [Ran05]. Research and informal reports indicate that aging adults understand that there is a tradeoff to be made between privacy and autonomy and they are willing to make that trade under the right conditions. [Mel04] [MMF+04] Some sensing techniques prove to be too intrusive and therefore not worth the autonomy tradeoff.

In later chapters I describe and evaluate the Digital Family Portrait, a single instance of the more general design concept described above. I provide evidence that its sensing infrastructure minimizes intrusion, yet its remote awareness display with its ability to investigate daily details is sufficient to support peace of mind for the adult child. Additionally, and surprisingly, there is evidence that it not only provides an increased peace of mind for the adult child but for the elder parent as well.

1.4 Thesis

I posit that a technologically-based social communication intervention which senses appropriate aspects of the elder parent's day-to-day life and provides the adult child living at a distance with an appropriate display of those aspects, functioning as a form of remote awareness, can provide the peace of mind needed by that adult child to allow the elder parent to continue aging in place.

1.5 Contributions

The first contribution of this work is the identification of "peace of mind" as an issue that threatens "aging in place." This research was begun by investigating issues of aging. Motivated by elder adult's stated desire to remain in the familiar surroundings of the family home, the desire to "Age in Place," coupled with the profound sense of loss associated with a move to institutional living, I began an investigation into what causes aging in place to fail. While there are many reasons that include illness and injury, I identified peace of mind as an issue for the adult child. Since my investigation also revealed the adult child as the person who frequently drives the decision for an elder parent to leave the family home for the relative safety of institutional living where "at least someone will check in on them from time to time," a lack of peace of mind can cause the consideration of such a move even before there is a clearly identified reason other than concern that something might happen.

A second contribution of this work is the description of a technological intervention design concept that addresses the above identified threat to aging in place. With the lack of peace of mind identified as a threat to aging in place the question became "Can a technological intervention mitigate this peace of mind deficit?" To address this question I visualized a design concept on which the Digital Family Portrait would eventually be built. This design concept can be described as social communication technology that uses sensing placed in the home of the elder parent to present a home appropriate representation of the well being of that parent to the adult child in the adult child's home.

A third contribution of this work is an iterative design exploration of the design concept outlined above. Having described a technological intervention design concept that addresses the threat presented by a deficit of peace of mind, I performed a detailed exploration of that design concept by building and iterating on instances of the Digital Family Portrait. Using mixed research methods this exploration led the design through iterations that arrived at a Digital Family Portrait deemed worthy of a year long field trial. Encouraging results from this field trial include that the representation and interpretation of activity mirrored actual activity in the home for both the elder parent and her adult child; that the design seemed acceptable for the elder parent to the extent of making her feel "less lonely;" that the adult child was able to interpret and use the data provided by the DFP and that he was able to couch the use of this data in a manner that was socially acceptable to his mother; and that the parent-child pair continued to use the DFP system long after the conclusion of the field trial and the cessation of monetary compensation.

There are five hypotheses put forward in my proposal. The aging adult's perceived/reported activity level is correlated to the sensor data collected in the home and that the adult child's interpretation of the levels portrayed in the Digital Family Portrait correlate to those perceived/reported levels. The Digital Family Portrait supports the adult child's feelings of awareness of the aging parent's well being and that it increases feelings of connectedness between the aging parent and the adult child. Finally the Digital Family Portrait is a socially acceptable form of technology. Details of the proposed hypotheses, the data collected and analyzed as well as the different piece parts

of those hypotheses and the supporting evidence are covered in greater detail in Chapter 5: Digital Family Portrait, a Year Long Field Trial.

A fourth contribution of this work is through the work's impact. One way that groundbreaking or innovative research demonstrates a contribution to the larger scientific community is through its impact on the world at large. This impact can manifest itself as media coverage in both the popular and scientific arenas. This media coverage is one measure of the research's ability to spark the imagination of others, causing them to think in new and different ways about old problems. Though this media coverage is, in itself, not a necessarily a contribution, it may be seen as one early predictor of its eventual contribution generating effect.

As an innovative approach to one of the problems associated with an aging in place failure, a lack of peace of mind, the Digital Family Portrait has sparked the imagination of both the popular and scientific media. A partial listing of its media impact is given in Tables 1, 2 and 3 below. This media's ability to spark the imagination and bring about further scientific contributions is evidenced both by the large number of subsequent research papers that directly reference the Digital Family Portrait but also buy the increasing number of research projects that use the data set generate by the Digital Family Portrait's field trial dataset.

Table 1
Digital Family Portrait Media Impact: Television and Radio

Television	
	ABC News Good Morning America, “Joining the Jetsons,” by Science Editor Michael Guillen, May 11, 2000.
	ABC World News Tonight with Peter Jennings “Enveloped in Technology,” March 11, 2001.
	Learning Channel, “Cabin Fever,” March 12, 2001.
	NBC Today Show with Katie Couric, Forever Young Series- "Help for Independent Living", 3/19/2002.
	ABC World News Tonight with Peter Jennings, “Enveloped in Technology”, covering ACM01, 3/11/2001.
Radio	
	NPR Morning Edition, “Computerized Homes - Techno-houses being designed to allow elderly continued living at home,” by Joshua Levs, August 15, 2001.

Table 2
Digital Family Portrait Media Impact: Print

Print	
	Wall Street Journal, ”Inside the Home of the Future: Houses that make your coffee, lock your doors and even measure your health are closer than you think,” by Kelly Greene, February 23, 2004.
	Business Week, “Computing That Only Looks Like Child’s Play,” by Faith Arner, November 3, 2003.
	New York Times - Circuits Section, “A ‘Smart’ Home, to Avoid the Nursing Home,” by Anne Eisenberg, April 5, 2001.
	Scientific American, "As we may live", by W. Wayt Gibbs, 11/20/2000.
	Atlanta Journal Constitution, Atlanta Tech Section, "A digital home sweet home", by Ernest Holsendolph, 5/10/2000.

Table 3
Digital Family Portrait Media Impact: World Wide Web

World Wide Web	
	'Smart House' Keeps Tabs on Far-off Family written by Maria Godoy, TechTV News, Friday, June 01, 2001, http://www.g4techtv.com/techtvvault/features/29837/Smart_House_Keeps_Tabs _on_on_Farof _Family.html
	"New Research Aimed at Helping Seniors Stay in Their Homes Longer", SeniorJournal.com, April 28, 2000, http://www.seniorjournal.com/NEWS/Features/12-19-1AwareHome2.htm
	"Aging in Place with Technology: Study Reveals Older Adults will Sacrifice Some Privacy to Remain in their Homes Longer", by T.J. Becker, Georgia Tech Research News, 5/6/04, http://www.gtresearchnews.gatech.edu/newsrelease/privacy.htm
	"Older Adults will Accept Monitoring Technology to Live in their Homes Longer" ,Global Action on Aging, http://www.globalaging.org/elderrights/us/2004/technology.htm
	"Helping Cooks Unsalt Their Game" by Mark Baard, Wired News, http://www.wired.com/news/technology/0,1282,55109,00.html
	"Home sweet Aware Home" , by Kimberly Rieck, Technique, http://new.nique.net/issues/2003-04-18/focus/2
	"No Place Like Home", by Jane M. Sanders, Research Horizons, http://gtresearchnews.gatech.edu/reshor/rh-ss02/age-side.html
	"Looking in on the Folks", Prism Online, American Society for Engineering Education, 2001, http://www.prism-magazine.org/mar01/briefings2.cfm
	"Monitoring Our Elderly", Design News , June 28, 2004, http://www.designnews.com/article/CA426247.html
	"The Role of Technology for an Aging Population", Submitted to the Special Committee on Aging, United States Senate, by Gregory Abowd, May 20, 2003, http://aging.senate.gov/_files/hr101ga.pdf
	"Independence, Except From Gadgets", by Jean Lawrence, WashingtonPost.com, Tuesday, December 18, 2001.
	"Tech innovations help parents remain home", Jan L. Warner & Jan Collins ,May 17, 2004, http://www.jewishworldreview.com/0504/nextstep051704.asp
	"Loving look", Exclusive from New Scientist Print Edition by Ian Sample, 28 February 2001 http://www.newscientist.com/article.ns?id=dn473
	"Grow old with grace high-tech inventions" , Beacon Journal, by Katherine Spitz, Beacon Journal medical writer , Sun, Nov. 09, 2003, http://www.ohio.com/mld/ohio/living/health/7219850.htm?1c

A final contribution of this work is the data set generated by the field trial. Captured in-situ this data set captures the movements and represents the actual daily activity of an elder as she lives out her normal life, alone, in her own home. Unusual and not previously

available from other sources, this dataset has already attracted the interest of researchers using this kind of real-life data as a test bed for their work. Two of these research groups have written papers on their research that uses the data set as a test bed. Allison Woodruff and Ryan Aipperspach at Intel/Berkely [ACC0X] have used this dataset to conduct their research into predicting future behavior based on past behavior. Irfan Essa and his student treated the data set as an event stream to conduct research concerning the unsupervised discovery and characterization of activities [HMJ+05].

Table 4 below ties the contributions in the form of published papers to the chapters in which the work is discussed.

Table 4
Published Papers Tied to Chapter of Discussion

	Chapter Contents	Published Papers
Chapter 2	Related Research	
Chapter 3	Contributions Initial aging in place investigation Initial Digital Family Portrait design Digital Family Portrait Woz simulation field trial	[MR00] [MRJ01]
Chapter 4	Redesign of Digital Family Portrait based on results of the Woz simulation Design and execution of in-lab study of icon size Design and execution of icon gender/meaning study	[RM05a]
Chapter 5	Contributions Design and execution of long-term field trial of the Digital Family Portrait Discussion of the results of the long-term field trial	[RM05a]
Chapter 6	Mapping the adult child's concerns to sensors Sensor selection for the Digital Family Portrait long-term field trial Discussion of sensor types Physical connection between sensor and computer	[RM05b]
Chapter 7	Future work Changing from pulsors to X10 wireless motion sensors Digital Family Portrait as early intervention Digital Family Portrait and medical monitoring	

CHAPTER 2

RELATED RESEARCH

2.1 Digital Family Portrait Research Background

My research which leads to the Digital Family Portrait addresses how to provide peace of mind about the well-being of an elder living at a distance in support of their desire to Age in Place. It is research that provides this peace of mind through social communication means within an extended family. I believe that this research is best carried out in-situ, especially when concerns of acceptance and the eventual adoption are central to determining ultimate research success. This belief is supported by the Anne-Sophie Melenhorst's dissertation [Mel05] as well as [Mel01] which both show that the value systems used to judge new media change as we age such that classic usability, ease of use and efficiency are not so important to an aging population as the perception of benefit. This research sits in that larger research space at a place where Aging in Place, social communication within the extended family, in-situ home research and remote awareness cross.

2.2 Awareness

Research in human-computer interaction has often addressed the notion of awareness; creating light-weight forms of interaction that allow users to monitor something of interest without causing undue distraction or incurring substantial effort. Interfaces for social awareness of other people include explicit representations such as media spaces [DB92] and abstract representations such as pinpoints of light on a wall, the sound of waves washing up on the beach [IU97], and balloons floating across the screen [PS97].

Likewise, interfaces can provide awareness of physical objects such as a bottling factory [GSO91] and virtual objects such as email.

Much of the research using computational systems to support awareness within the context of a complex, social environment has been carried out in the domain of workplace [DB92] [MBW+98] [PS97]. These studies provide the necessary backdrop as researchers examine these issues in the context of a different complex, social environment, that of the home and the extended family. Ishii's work in "Tangible Media" clearly demonstrates the connection between computation and the presentation of that computation in physical form [IU97].

One distinction between this work and previous efforts is my focus on portraying trends over a period of time. There has been substantial research is visualizing complex, time-varying data [CMS99]. Most efforts have used abstract representations (e.g. color, dots, lines) to depict trends and to enable the visualization to be read at a glance. My decision to use potentially more engaging visual icons hampers my ability to directly leverage previous visualization designs. However there is commonality in issues regarding using spatial location and color.

2.3 Connectedness and Emotional Awareness

This work is inspired by various designs that demonstrate connecting people in light-weight, emotional ways. One clear example is the "feather. " [SG96] This work involves the prototyping, but not the evaluation, of what the authors refer to as technologically-

mediated sociality. One of these prototypes, called “feather,” consists of two devices, one at each end of a social communication that occurs across distance. One of these devices acts as an intentional input the device, the other acts as an output device. When the input device, in their example a picture frame, is handled on one end of the mediated social communication, the output device, a feather in a tube with a fan, is blown up and allowed to float back down. Like the feather, my goal is to create an emotionally-engaging, light-weight, technically-mediated social connection between distant family members engendering a sense of security and well-being. Unlike the feather, my work does not require intentionality on the input side of the social communication to communicate connectedness and emotional awareness. Also unlike the feather which is intended to support simple intimacy without any specific ends in mind, my work is constrained by its intention to support social communication, social communication that supports an elder’s desire to age in place.

Familyware [GCI00] describes technology to provide specific support for sharing a “feeling of connection” between extended family members, as well as friends, that are separated by geographic distance. Familyware, as cited, exists as a central idea around which scenario based design methodology can be tested as a means of investigating user needs. The developed scenarios were tested against colleagues, graduate students at Yamanashi University and others with the intent to ultimately move to field trials. Various objects, such as a plush toy, can by manipulated to send a signal to a family member. This requirement for manipulation is one point that separates this form of interpersonal communication from my work which automatically re-establishes the

naturally occurring awareness that is lost when geographic distance is introduced. This work parallels the early DFP work in that it uses less costly methods to iterate the design before moving it to the more costly field trial arena. The results of a search on "Familyware" does not reveal any further publication concerning the advance of this work beyond this preliminary work.

But, there is another, deeper difference between Familyware as cited and the DFP research effort that stems from the initial focus, the intent of the researchers. They start their investigation at the "use technology to enhance inter-family communication" level. The DFP research, while it did have that phase in its research train, that "use technology to enhance inter-family communication" was arrived at by starting at a higher level, that of "what can be done to positively affect aging in place." While I will admit that there is an underlying assumption that research that is funded through the College of Computing will have technology of some sort incorporated in it, I did not start there. Rather, I began with a societal problem and arrived there through research.

Finally, there is a third difference. Familyware suffers from a lack of explicit constraint. While using technology to enhance inter-family communication is indeed what DFP does, approaching the subject at that level is problematic. Inter-family communication in its broadest sense a highly complex arena involving people of widely varying ages. A person's goal structure has been shown to change as they age and the criteria that they use to evaluate technology also changes [Mel04] In order to successfully design, test and iterate on a design intended for inter-family communication one form of inter-family

communication, or at least a class of inter-family communications, must be selected. Cross-generational inter-family communication is particularly problematic [MR00] and will not be effectively addressed unless the research is constrained to that class of inter-family communication.

In his talk at IDSA 1999, Bruce Tharp, director of The Netherlands Design Institute in Amsterdam, makes mention of the Nonogatchi, a device built around a pair of communicating tamagatchi-like devices. This device is intended to enable grandchildren to support their grandparents by providing medication reminders. While this device does support social connections between extended family members, it too requires active input by its users thereby differentiating it from my work. Since there is no available publication on this Nonogatchi device nothing further can be reported other than what was mentioned in the talk and subsequently reported here.

Work by Gaver et al. examines computing technology to help link older adults with their local communities [GD99]. Taking place in the Bijlmer, a planned housing development in the Netherlands, this was design research intended to increase the elder's presence among the residents living in the development in ways that were important to the elders. Rather than having the intent to diagnose and then propose a solutions to the elder's problems the researchers used the less direct approach of opening a dialog with the elders about possibilities. "Cultural probes" were used as a means of eliciting "inspiration-clues" about the elder's attitudes, aesthetics and desires rather than gathering information about the elders through more traditional methods. These cultural probes were then used

to brainstorm and generate proposals. From these proposals a storybook was built as well as interactive simulations. These were then shown to elders to elicit their reactions when imagining the world presented in the simulation.

My work parallels the methodological approach taken by this work, though it does strike a middle-ground between, on one hand, a highly structured approach in which the questions are known and research is strongly directed by those questions and, on the other, a completely unstructured approach in which elucidating the questions is the main intent of the research. This I claim due to my insistence that the formative research be carried out in the field and in the homes of those the research was meant to affect and that the ultimate evaluation be carried out in-situ. My work complements these efforts, by focusing on strengthening the connections between older adults and the outside world, in their case between the elders and the community they live in, in my case between the elder and their relatives. Additionally, in both efforts, the question of how to represent an older adult to an outside viewer is one key issue.

Casablanca [HML+01] through its use of ethnographic-based research methods, explores how social communication devices could be incorporated into the home. In a series of interviews, brainstorming sessions, field trials coupled with prototype development and focus groups it uncovers some interesting home-related characteristics and presents guidelines for the design of social communication devices to be used in the home. While not directly addressing issues of Aging in Place, it does serve to reinforce my methodological stance that, the home domain is very different from other domains and

research concerning the deployment of technology in that different domain should ultimately be conducted in-situ. Finally, it reinforces my methodological stance that age is an important criteria for the choice of participants used in any other than the most preliminary research stage by being careful to select participants from the age group that the technology is intended for.

By providing a virtual shared space in the form of chest of drawers, Itiro Siio's Peek-A-Drawer [SRM02] [SRM+03] provides support for social communication between extended family members across distance. Placing an object in the top drawer of one chest of drawers causes an image of that object to appear in the bottom drawer of the remote chest of drawers and vice versa. Intended for use by a grandparent/grandchild pair it supports Aging in Place by addressing the social communication needs of the distant elder.

An initial field trial of the Peek-A-Drawer prototype was conducted for a period of six months in which a pair of Peek-A-Drawers were installed, one in a granddaughter's home, the other in a grandmother's home some 300 km distant. During this field trial in excess of 200 images were sent between the participants. The device was highly prized by the grandmother who experimented with "sending" a variety of different objects to the grandchild, sometimes including explanatory notes along with the item. The granddaughter was less enthusiastic than the grandmother about the device but still placed objects in the drawer and checked for her grandmother's response.

This field trial pointed out some important issues that underlie any attempt to use technology to mediate cross-generational communications, issues that I also discovered during the DFP research. Both my research and this research used a completely symmetrical device deployment in that both ends of the social communication had exactly the same equipment. In this field trial, as with the Wizard of oz simulation (Woz) field trial of the DFP the interest in the use of the device was not equally balanced between the grandchild and grandparent side. It was clear that it was highly favored by the grandparent but, though they participated, the grandchildren were less than enthusiastic. From this it seems that a completely symmetrical device deployment better meets the needs and interests of the grandparent and misses the mark for the grandchild. Drawing from the idea of balanced symmetry that is seen in graphic arts where the composition is balanced, but not perfectly symmetrical, leads me in later cross generational social communication work to consider the needs and interests of each participant and produce a balanced, not completely symmetrical device deployments.

CareNet, [CRS04a] [CRS04b] [RCS04a] [RCS04b] research carried out at Intel, addresses the informational needs of the elder's broad care network to provide Aging in Place support for the elder. In the first phase of their research they identified five of these stakeholder groups; the elders, familial caregivers, professional caregivers, family members, and geriatric care managers, mapped their relationships to one another and their level of care involvement.

Through semi-structured interviews of these five stakeholder groups followed by roundtable discussions the CareNet research team has identified and ranked the importance of a list of 22 different types of information needed by the elder's care network in order to support their Aging in Place. Two of these information types, sleep and financial information, were uncovered in interviews conducted after the ranking exercise was complete but are included in this table as "unranked" in formation types. The five measures of well-being that I identified from interviews, four of which were selected for representation in the first Digital Family Portrait design, can be seen as a superset of the 22 different information types identified by the CareNet research team as shown in Table 5 below. A future phase will take the results of these sessions and test various designs in-situ.

Table 5
Comparing CareNet Information Types to DFP Measures of Well-being

CareNet Information Types compared to Digital Family Portrait Measures of Well-being		
CareNet		**Digital Family Portrait**
Ranking		
1	falls	health
2	meals	
3	disease-specific measures	
4	medication	
5	vitals	
6	mood	
12	weight	
15	bathing	
19	toilet use	
13	water intake	
unranked	sleep	
8	household needs	environment
unranked	financial information	
9	activities	activity
17	distance walked	
17	dressing	
7	calendar	
10	outings	events
16	car trips	
11	visits	relationships
14	messaging	
18	phone calls	

A long term study of elders and their caregivers, the ELDer Project [HFH+00] used participants drawn from a seniors' community and found that social, emotional, and environmental factors are important to the adoption and use of new products. This being the case, the subjects of this study have already made what I consider to be the critical transition from the home to a seniors' community. For these subjects, aging in place has already failed. My research is conducted in the family home and involves independent

living elders and their distant extended family. As such, my results may have some applicability to the ELDer Project in that distance, once an elder resides in a seniors' community, is greatly reduced. Care must be taken, however, to consider privacy issues when transitioning from family caregivers to institutional caregivers.

2.4 Commercially Available Products

There are a variety of commercially available Internet-connected picture display devices on the market that are similar to the Family Tree [Phi05a] device of Philip's 1996 Vision of the Future, an interactive picture frame that brings together existing family archive material such as videos, photographs, letters, names and dates with current information about the family. These devices are fundamentally different from the Digital Family Portrait in that these merely display previously loaded pictures. They require authoring, are not connected to any remote sensing devices, and are not collecting or displaying history.

In Japanese culture, the making of tea has a special, ritualized stature. The Internet Tea Kettle [Mim05] is a teapot, to be used by an elder, that reports over the internet to the concerned adult child when it has been used. The assumption here is that regular use of the teapot is somehow indicative of normal behavior and serves to inform the adult child that things in the home of the aging parent are just fine. While the internet teapot presents a narrowly focused representation of the well-being of a distant elder that relies on cultural norms and, as such, has limited direct applicability to other cultures it may be possible to easily extend it in concept to fit those other cultures.

CHAPTER 3

INITIAL DESIGN AND WIZARD OF OZ FIELD TRIAL

3.1 Contribution

The design process of making an instance that exists in the physical world from a design concept, namely moving from the concept of an awareness appliance reflecting sensing in another home to a portrait with remote sensing information visualized as part of the portrait frame, is one of the contributions described in this chapter. Although the design has changed considerably over the course of this research, the concept of an enhanced portrait and its name, the "Digital Family Portrait" has remained constant.

This chapter also describes a Wizard of oz simulation (Woz) field trial of the initial design of the Digital Family Portrait that I conducted using an interview-based simulation of sensor data and a hand-built display that changed only once a day. The participants in this trial could see Digital Family Portraits that I built by hand from information that I gathered from daily phone interviews to simulate gathering information from sensors placed in the participant's environment. In this way I acted as the "wizard" behind the "curtain" making things appear to be more functional than they actually were, in other words, simulating the system before having to build it. There were five participants viewing three Digital Family Portraits; a grandmother, a granddaughter with her parent and a grandson with his parent living in three different locations. The underlying form of the Digital Family Portrait and the means of information display was the same for all three participants while the actual final display varied, choosing icons and backgrounds that I thought to be appropriate for each of the participants.

Contributions from this field trial include the finding that such a design is not rejected out-of-hand, or that at least on some initial level it is acceptable for use in the home, and the discovery that, even though the form of the Digital Family Portrait and the nature of the information portrayed on the display were the same for all three sets of participants, there was a usage difference that is split across generational lines. It also became clear that a perfectly symmetrical design might not be required to achieve our design goals but rather that a reciprocal design might better serve participants from different generations. In this instance I take "symmetrical design" to mean that the same information is collected about both participants; this information is processed in the same manner and the results are displayed in the same format on similar devices. Contrast this approach to a "reciprocal design" in which social communication between participants from different generations is supported but the display and interaction is tailored to suit the needs, interests and capabilities of each participant individually.

Also to be considered as contributions are those findings that suggested a re-design was needed. Densely packed information, rather than providing an easily readable overview display of the well-being of the person depicted, instead served to confuse the display's meaning. Density, then, would destroy the intended "browse-ability" of the display. Additionally, subjects showed a great degree of sensitivity to the icon chosen to depict well-being with the result being confusion about or a misunderstanding of the display's intended meaning.

3.2 Designing a Portrait

3.2.1 Initial Design

To move from the design concept previously specified in Chapter 1 to an actual instance of such a device that can be the subject of a field trial requires that choices be made. The first choice made was that actual sensors would not be used. Instead, the sensors would be simulated using a Woz simulation. Since a social communication support for peace of mind in service to aging in place is innovative technology, concern about sensor choice and placement at this early in the design process would detract from far more pressing concerns.

Primary among these concerns was the question of what form factor the display would take. Working from the assumption that since it would be displayed in the home it needs to be home appropriate and should be emotionally engaging. Selecting the picture in a frame as a display device from among the many different items found in a home seemed particularly appropriate since it was an object already found in the home and already used to represent a person. With the decision to use a picture in a frame as a display, the next question to be considered was where to place information?

One obvious place to embed information is in the image itself. Since a person's representation in the world is something that is generally carefully crafted, manicured and maintained, manipulating the image itself to reflect some change in the person that is being represented, while it is technologically possible ("Look, grandma is having a bad day, she has turned grey!") was not considered beyond cursory brainstorming. If

manipulating the image is out of bounds, then information fields could be placed on the image itself in "unused" portions of the image like the background. This approach would require that each picture be individually considered for information placement which requires each display be customized to fit the particular image. This, in addition to not wanting to change the representational image, caused the rejection of this approach.

One option would be to associate a display with a picture in a frame with the display either being a side piece or the image being a decoration on the display. This approach would violate the desire to make an emotionally appropriate, home based display that would blend in rather than stand out in the home. This kind of design, if placed in a public portion of the home, would attract undue attention to itself when company is being entertained.

If the image is out of bounds and an associated display violates the design criteria, that leaves the picture frame as a potential design element. Embedding information in the frame itself is an attractive idea on a number of levels. First, frames are frequently decorative in themselves, making them less distracting to those visiting the home since decorative frames are normally found in the home, solving the public-space placement problem. This decorative nature of frames also reinforces that the display be qualitative and emotionally appropriate in nature rather than more quantitative and clinical in nature. Additionally, frames have four sides giving rise to the possibility of naturally accommodating up to four different pieces (or categories) of information. Finally, picture

frames are frequently quite large with respect to the picture itself allowing for a lot of display "real estate."

My name for this social communication device that supports aging in place by providing peace of mind about a distant person's day to day well being is the "Digital Family Portrait." In this chapter, I describe our first design including initial attempts at understanding what information needs to be portrayed and how to visualize this information in a picture frame.

3.2.2 What Needs to be Portrayed?

What kind of information is needed to provide day-to-day assurance of an extended family members well-being? In some cases, one simple indicator provides enough information to support the adult child in the belief that his aging parent is "doing just fine." One subject reported that knowing that his father has picked up the mail in the morning is enough to provide the necessary peace of mind, and make him comfortable with his decision to allow his father to remain at home.

Interviews with adult children and their aging parents, some living in institutional care settings and some living independently, led me to formulate general categories of information about daily life that are often shared between family members. These categories serve as a guide to what kinds of information support peace of mind.

- **Health:** In general terms how they are feeling that day. Did they sleep well? Eat regularly? Get enough exercise?
- **Environment:** The "health" of the environment. Has the weather been pleasant? Is something in the house broken?
- **Relationships:** Interaction with other people is important to one's emotional well-being. This category includes a range of social interactions, whether in person, on the phone, or through written correspondence.
- **Activity:** The general level of physical activity can be a good indicator of the caliber of a person's day in both extremes. A lower than average level of activity may indicate declining health, while a higher than average level of activity may indicate the onset of incessant wandering behavior.
- **Events:** The occurrence of special events is an indication of the richness and variety in a person's life. This category includes activities both planned and unplanned, as well as special outings.

Clearly these categories are not mutually exclusive. For example, a planned hiking trip with friends is a combination of three categories: activity, relationships and events. And a subsequent twisted ankle would show up under health and activity. My goal was not to create orthogonal categories, but rather to outline the kinds of things people talk about when they check in with each other.

3.2.3 Visualization Design Goals

From my initial field work, I set these high-level goals for my design:

- The design should convey relevant information about a person's daily life to support low-level awareness of that person's well-being.
- The design should depict trends over time for the different categories of information represented.
- The visualization should provide a qualitative view respecting privacy concerns.
- The visualization should be aesthetically pleasing, a typical home decoration.
- The visualizations should be emotionally appropriate, conveying "negative" information (e.g. a bad day) in an appropriate manner.

Because I was interested in depicting trends in a person's daily life, I rely on the notion of measurement. At some point in the system, a quantitative value is calculated based on the collected information. However the intent of the interface is to provide a qualitative sense of that information underlying that number. This choice represents a middle ground between displaying numbers, and displaying snapshots of daily life. Examples of the first version of the digital family portrait is shown in Figure 1 which is the grandmother Constance's Digital Family Portrait and Figure 2 which is the granddaughter Caitlin's Digital Family Portrait.

3.2.4 Symmetrical Displays

In this first field trial of the first instance of the Digital Family Portrait I chose to collect the same information about each of the three participants and to display that collected information in a Digital Family Portrait of the same design; only varying the icon choice and background color. I made the choice of icon and background color to support the person being *represented* in the Digital Family Portrait but the four categories of information displayed (events, health, activities, relationships) were the same and were displayed in the same position of all three Digital Family Portraits.

For this first field trial, it made sense to keep the design symmetrical. By doing this, I could argue that even though a person did not have access to their own Digital Family Portrait certain privacy concerns would be addressed. Since they did know the nature of the information being displayed and the kind of things that can be learned from that information through their exposure to their relative's Digital Family Portrait, they could maintain an idea about how they were being represented.

From the results of this research in which people of very different ages communicate using identical information displayed through identical means it became clear that a change was needed. In later research involving this kind of cross-generational communication I take into account the different needs, interests, skills and capabilities brought by people of differing age. Communication across generations can still be reciprocal, but the interaction should be tailored to the generation doing the interaction and therefore not be required to be symmetrical.

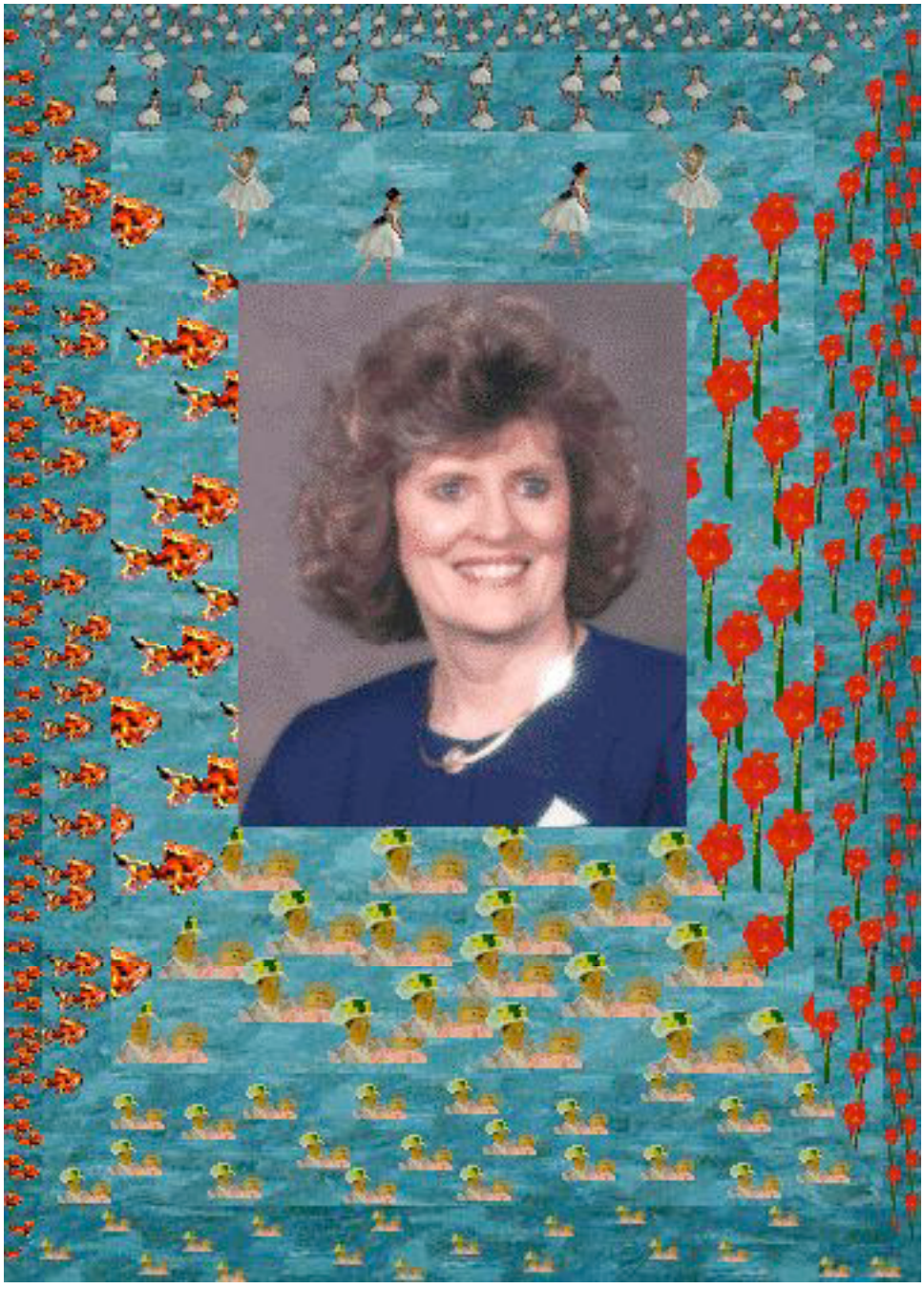


Figure 1
Constance's Digital Family Portrait

Figure 2
Caitlin's Digital Family Portrait

Wanting to augment a traditional picture frame, I chose to represent health, relationships, activity and events (one category for each of the frame's four sides). Health is represented by the right side of the frame and moving clockwise are representations for relationships,

activity and events. A typical photograph occupies its standard position in the center of the frame.

3.2.5 Representing Time

In this digital family portrait, time is not represented as a continuous flow, but rather the past eleven days are divided across three distinct bands. Refer to Figure 3, the relationships portion of Caitlin's Digital Family Portrait shown in Figure 3 above, for the discussion of these bands. The band that is closest to the photograph (in Figure 3 this appears at the top) represents one day, the current day. Outside that is a second band that represents an average of the three days prior to the current day. The third and final band lies at the outermost portion of the frame and represents an average of the seven days previous to the days represented by the inner two bands. Simply put, the closer one gets to the photograph, the more recent the information, and the less time is compressed in the representation. To reinforce the idea that time passes as one views the outer portions of the frame, the background of each band gets progressively darker and narrower, and the icons diminish in size.

3.2.6 Representing Levels

The density of icons in a band represents the measurement for that category, for that time period. Determining density within a display field that is different width and length as well as non-square ends is complicated enough to warrant some explanation. Since the icons are different shape, size and color the density within the presentation field for this Woz field trial was defined as the ratio of the number of pixels for all the icons present in

the field to the number of pixels available in that field. The greater the density of icons, the higher the measurement is for that category. For example, viewing the events portion of Caitlin's portrait (shown at the top of the Figure 2 and by itself in Figure 3), it can be seen that she attended fewer events during the current day (as shown by the bottom band of Figure 3), far fewer than she had been attending in the past (shown by the upper band of Figure 3). This difference indicates a decrease in her attendance of events over her recent history.

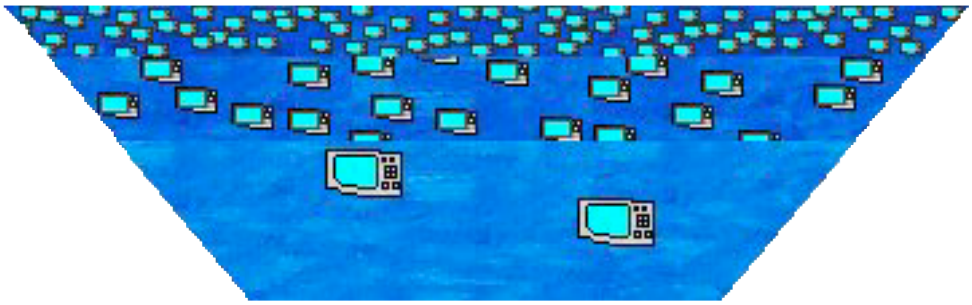


Figure 3
Events Portion of Caitlin's Digital Family Portrait

Inversely, it can be seen that more recently (most recent is shown as the upper of the three bands) relationships (seen at the bottom of the complete frame shown Figure 2 and by itself in Figure 4) is shown to be at a greater level recently than it has been in the past.

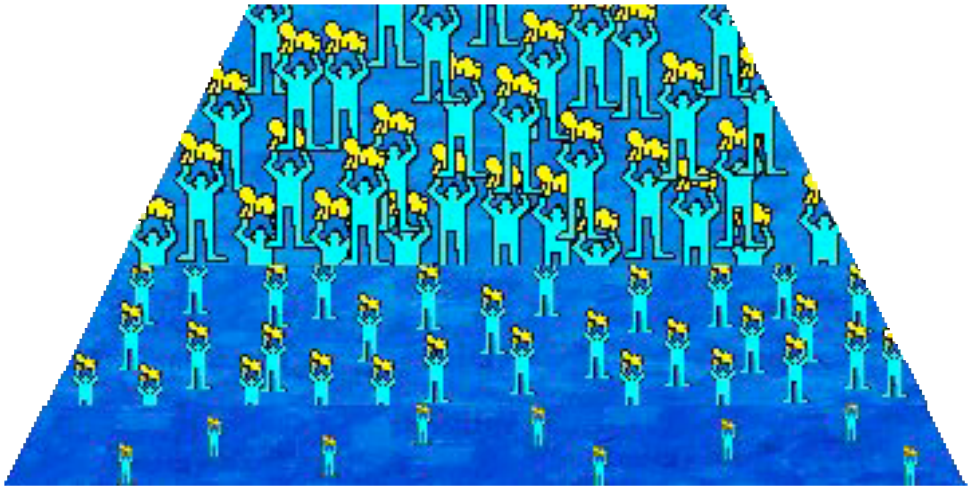


Figure 4
Relationships Portion of Caitlin's Digital Family Portrait

3.2.7 Icon Selection

There are a number of design alternatives for conveying my categories of information. At one extreme, I could use explicit representation such as text and raw numbers or bar charts. Although these would be easier to decipher, their "scientific" quality did not match my aesthetic goals in creating a typical picture frame. At another extreme, I could use abstract representations such as a color spectrum. This design seems less engaging than icons and less likely to trigger conversations between family members. My choice of visual icons represents a middle ground. The icons have some connection to the categories and are intended to be engaging. Tables 6 & 7 summarize the icons for both the grandparent and the grandchild.

Table 6
Grandparent's Icon Set

Grandparent				
Category	Description	Icon for day 1	Icon for days 2-4	Icon for days 5-9
Health	O'Keefe Flower			
Relationships	Cassat Mother and Child			
Activity	Anon. Fish			
Events	Degas Ballet Dancer			

Table 7
Grandchild's Icon Set

Grandchild				
Category	Description	Icon for day 1	Icon for days 2-4	Icon for days 5-9
Health	Keith Haring baby			
Relationships	Keith Haring Mother and Child			
Activity	Keith Haring Dancer			
Events	Keith Haring TV			

Designing representative icons for the grandchildren and the grandparents presented interesting challenges. The grandparent design was the more difficult of the two and is illustrative of the general issues encountered when designing any set of icons for small frame areas. Since they evoke a more genteel theme and seemed to be well suited to the

home of a grandparent, I chose to select from the works of the impressionist painters for iconic designs that would represent the different aspects of the grandparent's life. Impressionist painters worked with a wide range of subjects including landscapes, portraits and the traditional still-life which made finding images that worked, and were recognizable, in the small scale required when appropriated for use as icons a difficult task since grand schemes like groups of people, tables set for a family meal, fields of haystacks, lily ponds and bowls of fruit were all too large be meaningful when reduced to fit within this restricted space.

Drawing out small pieces of this work yielded Degas ballerinas used as icons to represent events and Cassat's mother and child used as an icon to represent relationships. I compromised on the two remaining categories. The fish icon that represents activity is highly adapted from other work and the flower icon that represents health is work by Georgia O'Keeffe (who is not from the Impressionist period). All the same the Impressionist representational theme was a useful idea to organize my thinking.

The representation style chosen for the icons used in the Digital Family Portrait reflects the represented person. Just as traditional picture frames reflect the person represented in the photograph that they surround, the icons chosen for use in the digital family portrait's frame have been chosen to reflect the person being represented in a way that is consistent with their own self image. This choice is akin to how people use picture frames today (e.g. rattles or storks with a newborn portrait), the frames are matched to the contents, not to the viewer. For example, the grandmother's digital family portrait uses images from

Impressionist paintings, with colors that are subdued, in harmony with the image a grandmother might like to project. In contrast, the frames for the grandchildren use images derived from paintings by Keith Haring, creating a more playful image that is indicative of the image a child might project.

3.3 Woz Field Trial

Since technology intended for use in the home, especially technology that is to be used by older adults, for reasons of ecological validity is best tested in its context of use. Very early on in the process of reviewing possible subjects for an in-home Woz field trial, I found a grandmother who had two grandchildren, one male, the other female, all of whom lived at some distance from one another. While communication between grandparents and their grandchildren was not the ultimate intended use for this technology, the choice of a grandparent-grandchild pair would benefit from the advantage that a senior adult would be highly motivated to share information with, and learn about their grandchildren. Additionally in this study a third party, the adult child, was also an observer and could view the information about their aging parent. In this nine day field trial [MR00], I created daily digital family portraits for a grandmother (Constance) and her two grandchildren (Mark and Caitlin).

I wanted to test the first version of the display with people in their own homes as the subjects, even though there was no deployable sensing infrastructure currently available. I opted to create a simulation of the output of a possible future sensing infrastructure by hand. I did this by conducting daily telephone interviews with the three subjects. During

these daily interviews, we asked questions to elicit information relevant to the four chosen categories of health, relationships, activity and events. From their responses, I assigned a rating of between 1 and 10 to represent the level for that category for that day. From this interview-based simulation, I was able to hand-build the digital family portrait for each subject, each day of the trial.

For this field trial, each subject was provided a laptop, modem and Internet accounts so that they could view the digital family portrait as a WWW page. After the interview, each subject viewed their digital family portrait for that day, and answered a daily questionnaire providing their qualitative impressions.

3.3.1 Field Trial Results

With review of the pre- and post- interview data, the daily phone interviews and the daily diary sheets that all three participants produced, a number of results were noted. For the interview guidelines for these interviews as well as an excerpted transcript refer to Appendices C through G.

Although the design was intended to be read "at a glance," it was nevertheless too complex. In particular, redundant cues for time (icon size, location, the width of the band and the background color) did not fuse well and instead caused contradictory interpretations. Additionally, I was overly optimistic that I could convey ten levels of information. Constance was able to notice and interpret gross changes in the data. From the data, it is clear that the grandkids were not judging activity by the density of icons

displayed in the frame, but rather were simply counting the number of icons, an approach that led to erroneous results.

An interesting discovery of the study was the way in which the different subjects used the digital family portrait. The grandkids usually came in from school and looked at their portraits to "see what grandma was up to," while the grandmother reported that she went back to the portrait several times during the day, even though she knew that the portrait was only updated once a day. This observation supports the notion that designs should be tested in authentic surroundings. It would have been difficult to predict that someone would engage a static display several times in the same day, except that, in retrospect, that is exactly what people do with portraits hanging on a wall.

During the field trial, it was challenging to map information about daily activities gathered during interviews to my four categories. Mapping one event to multiple categories was common. For example, a sporting event counted as relationships, activity and as a special event. I anticipate that my inability to map information to single categories is not a fault in the design, but a reflection of the richness of everyday life. It is clear that individual lives are varied and that there are few canonical behaviors that all people share.

We anticipate that the final system will need to individualize the components (e.g. gardening or tennis) that make up the more general categories. Finally, some information will always be out of the reach of any sensor, such as the aforementioned sporting event.

Even though calendars and other sources of information can be construed as sensors, the portrait will always be incomplete.

During this field trial, the subjects reported that changes in the portrait led to the initiation of phone conversations that were grounded by the shared artifact (e.g. “You have lots of dancers today.”) Of interest is whether phone conversations will still be affected with the long-term use of the digital family portrait. Also of interest is Constance's habit of viewing the portrait multiple times a day, even though she knew that the data changed once a day. The portrait's persistent, yet “fresh” representation, seems to be a nice match to transitory, and often rushed phone calls. Although unable to interpret all the information encoded in the frame, it seems clear that Constance found the frames emotionally engaging.

Exit interviews revealed that the iconic representation chosen to depict each of the four different categories of a person’s daily life to be displayed on the frame could be the source of some confusion. Caitlin reported that she was wondering why fish icons were chosen to represent Constance’s activity because “grandma doesn’t like fishing.” In addition to this I suspect that icons also have a strong gender bias and therefore should be carefully chosen since many of the icons seemed particularly feminine.

CHAPTER 4

A STRATIFIED DESIGN

4.1 Contribution

Iteration on the initial design of the Digital Family Portrait, the instance to rise from the conceptual design, and the Wizard of oz simulation (Woz) field trial that are detailed in the previous chapters is the contribution of the work presented in this chapter. Using mixed research methods this exploration led the design through iterations that arrived at a Digital Family Portrait deemed worthy of a year long field trial. Rather than trying to represent four different categories of information pertinent to the well being of an aging parent on a single persistent display, I reduced the complexity of the display by displaying a single category per display, changing the way that time is represented on the display and by changing the way the level of the category is displayed. Activity level was chosen as the single category to be displayed. Rather than having three bands around the image that represent 11 days of activity, I chose to have a single icon represent a single day's activity and rather than having the icon density represent the level of the category, I chose to use the size of the icon to represent the level. The frame allowed for the display of 28 icons, one for each of 28 days, displayed 7 to a side, one for each day of the week. With this approach 28 days could be seen individually rather than having only 11 days compressed into 3 bands.

In addition to these changes, I stratified the design by providing for the display of a second, detailed display of a touch-screen-selected single day. By touching the icon for

the day of interest, this second detailed display is designed to support the adult child's investigation into the details of the displayed category.

4.2 Redesign

The previous evaluation of the Digital Family Portrait in a Woz field trial exposed problems with the design as tested. Using icons as an emotionally engaging and home appropriate means of representing aspects of a person's life proved problematic because icons carry their own inherent meaning. Representing level as icon density was misinterpreted. Rather than judging the density of icons which was intended to be a comparison of the total number of pixels of icon against the number of pixels of background, it appeared that the participants simply counted icons. The complex, redundant method of presenting time as three different sized bands of three different sized icons with three different shades of background, rather than reinforcing one another and contributing to meaning simply proved to be too confusing. Finally, the representation of four different aspects of life on one display when added to the complexity of representation of time made the display generally too complex to be reasonably interpreted.

4.2.1 Designing for a Set of Portraits

With the results of the Woz field trial, I set the following as goals for the next design iteration.

- Create a stratified design to reduce the display's complexity:

- A simplified persistent display with only one aspect of life
- Change the way level is represented
- Change the way time is represented

- Develop a set of iconic designs that are appropriate for male and female senior adults.
- Focus on elder parent to adult child social communication.

4.3 Reducing Display Complexity

4.3.1 Stratified Design of Persistent and Detail Display

One result from my first field study, as well as from informal canvassing in our lab, was the overall positive reaction to the notion of a dynamic picture frame. People seemed enthusiastic about embedding relevant information in the frame while leaving the photograph unaltered. However, in my first design, there was simply too much information in one frame. As the practice of having multiple pictures of loved ones is common, I opted to distribute the different information categories or life aspects across multiple frames. This way the users could opt for only one category of information, such as general level of activity, and have only one frame displayed or they could opt to display multiple categories by using multiple frames.

4.3.2 Depicting Level of Measurement

In the Woz field trial, users had difficulty perceiving ten levels of measurement for each category, as well as interpreting what ten different levels could mean. I also had difficulty mapping interview data into these ten different levels. For this redesign, I decided to limit

the number of levels to four, two middle levels that represent normal fluctuations in day-today life, and two more extreme levels.

Reacting to my first design, many assumed that the size of the icon was mapped to its level. Following this intuition, in this design I map icon size to level, bigger icons for higher measurements. Working from the set of icons selected using the paper questionnaire, I chose four different sizes of each icon and then empirically verified that users could discriminate them using a fixed-choice, computer-based experiment. Using random presentation with a between subjects design, 15 subjects indicated whether a target icon was larger, smaller, or the same size as the stimulus. Since the aspect ratio of an icon affects how it is perceived in vertical and horizontal presentation the experiment presented icons in both horizontal and vertical presentations.

4.3.3 Representation of Time

While the initial Woz field study indicated that users wanted historical information to help them identify trends as well as to help them interpret the current day's icon, the goal of having older information slowly fade to the edge of the frame did not prove tenable. Borrowing a different metaphor for time, in this design the icons are presented around the frame in a clockwise motion. Instead of aggregating information as in the previous design, 28 days (7 days on a side) are arranged on the four sides of the frame. I reinforce this clockwise progress of time using multiple cues. First, the current day is colored white, making it distinct from the historical icons. Second, the current day and the recent past is highlighted using a gradient of background color, creating a "wave" of the forward

progress of time. Finally the color gradients used within all but the current day icons match the clockwise motion.

The persistent display, as redesigned, is considerably reduced in complexity. Gone are the redundant time cues, replaced by a straight forward serial presentation of nearly a month. Gone is the required reading of icon density to determine level, replaced by icon size discrimination. The resulting simplified display is considerably more straight forward. This leaves the confusion caused by intrinsic icon meaning to be addressed.

4.4 Icon Development

Even though each frame could potentially include a textual description of the category it represents, for reasons described earlier, I wanted the icons in the frame to carry the meaning for the frame. Interview data collected during the Woz field trial pointed out that icons can have and intrinsic meaning and that this could cause confusion. Case in point is the use of fish to represent activity for the grandmother. The grandchildren were confused by the fish because they knew that their grandma doesn't fish, prompting them to ask

> "Did momma (Constance) go fishing?"

Additionally, based on external reviews of my design in our laboratory, I realized that I needed to provide both gender-appropriate and gender-neutral icon options. Further my experience converting interview data into category levels led me to the conclusion that

the event category was not as useful an indicator as the other three so events were dropped from the second design.

Selecting icons from a clip-art database, I created an initial collection of 18 icons that seemed like good matches for the three remaining categories (health, relationships and activity) and gender options (male, female and neutral). Using a paper questionnaire, I asked twenty respondents to match each icon to one of the three categories, and also rank it on a seven point scale from very masculine to neutral to very feminine. Included as respondents were a mixture of ages and gender. This method proved effective in identifying the most appropriate icons. Active animals (e.g. butterflies and fish) were high matches for activity. Representations of health include a daisy, an apple, and a large tree. Pairs of animals (parrots, swans) proved to be a good match for relationships. The most difficult challenge has been finding a male relationship icon as all icons in this category tended to be rated as feminine. Although not entirely satisfactory, in the end I chose the telephone icon to represent male relationships.

A display of the developed icons, the paper questionnaire used to evaluate gender and intrinsic meaning category as well as a spreadsheet of icon categorization results and graphs of icon gender results refer to Appendices H through K.

Additional in-home interviews of elders were planned for two reasons. First, the interviews of seniors that I had conducted up to this point involved seniors who had already made the decision to move from the family home to some form of institutional

living. Having already made the decision to move, I feared that for those elders there would be a strong inclination for post-hoc rationalization of that decision. I wanted to interview elders at a time before the question is on the floor and before the decision was made. In addition to that it provided an excellent opportunity to do a first sanity check of the redesigned DFP by those people who the DFP was meant to represent.

In this effort I interviewed five households, three individual seniors, one senior husband and wife pair and one father and son pair. For excerpted interview transcripts of these interviews, refer to Appendices L through O.

4.5 Focus on Elder Parents and their Adult Children

4.5.1 Marking Trends and Alarms

During interviews with adult children and their elder parents issues of emergency and alarm frequently come up first. The adult children want to know if the fire alarm or the burglar alarm is going off. Also, the adult children express concern about the development of trends over time. “Has Mom been gradually getting less and less sleep over time by going to bed later and later?” To address these issues, in the redesigned Digital Family Portrait, there are additional ways in which pertinent information such as alarms and trends could be shown in the persistent display. One example of this pertinent information is a situation in which the computer has noticed a trend hidden in the sensor data. Since many variables could contribute to the visualization, a specific variable could be consistently abnormal, but masked by other sensor data. In this redesign, a trend is marked by a succession of dots outlining the frame. For example, in Figure 5, a trend of

poor sleeping is indicated. In future designs, the user can act on this knowledge and request more detailed information about this trend.

Although the portrait is not intended to alert the user to a crisis, it nevertheless should reflect when a crisis has occurred. In the example also shown in Figure 5, the icon for the day in which a crisis occurred is notched in toward the center, breaking the natural flow around the frame. The example crisis shown in Figure 5 is also followed, judging by the icon sizes, by two days of poor health and then a rebound.

As discussed above, in the design of the Digital Family Portrait I provided for the signaling trends recognized within the data as well as for the signaling of a crisis detected outside of the Digital Family Portrait system. While these are important capabilities, they were outside the bounds of what would be a reasonable first long-term field trial of the Digital Family Portrait. They are outside the bounds because, in order to be able to know what a trend looks like within the data I have to know what the data itself looks like. Prior to the installation of sensors and the year-long gathering of data I did not know how many sensor "hits" would occur on a low-activity, normal-activity or high-activity day so trend analysis routines that would recognize trends were not reasonable to build prior to the study.

Finally, crisis recognition originating from outside the Digital Family Portrait system would require those systems to exist unless there were to be set up some kind of Woz simulation that would artificially interject some kind of outside crisis. If I had chosen to

incorporate and use a Woz simulation to interject artificial crisis into the system then the data generated by the year-long field trial would be corrupted by this interjection, rendering it less useful as a set of in-situ gathered data. It would lose one of its most valuable after-the-fact characteristics, that it is representative of how one aging parent lives out her life, living alone in her own home, over the period of a year.

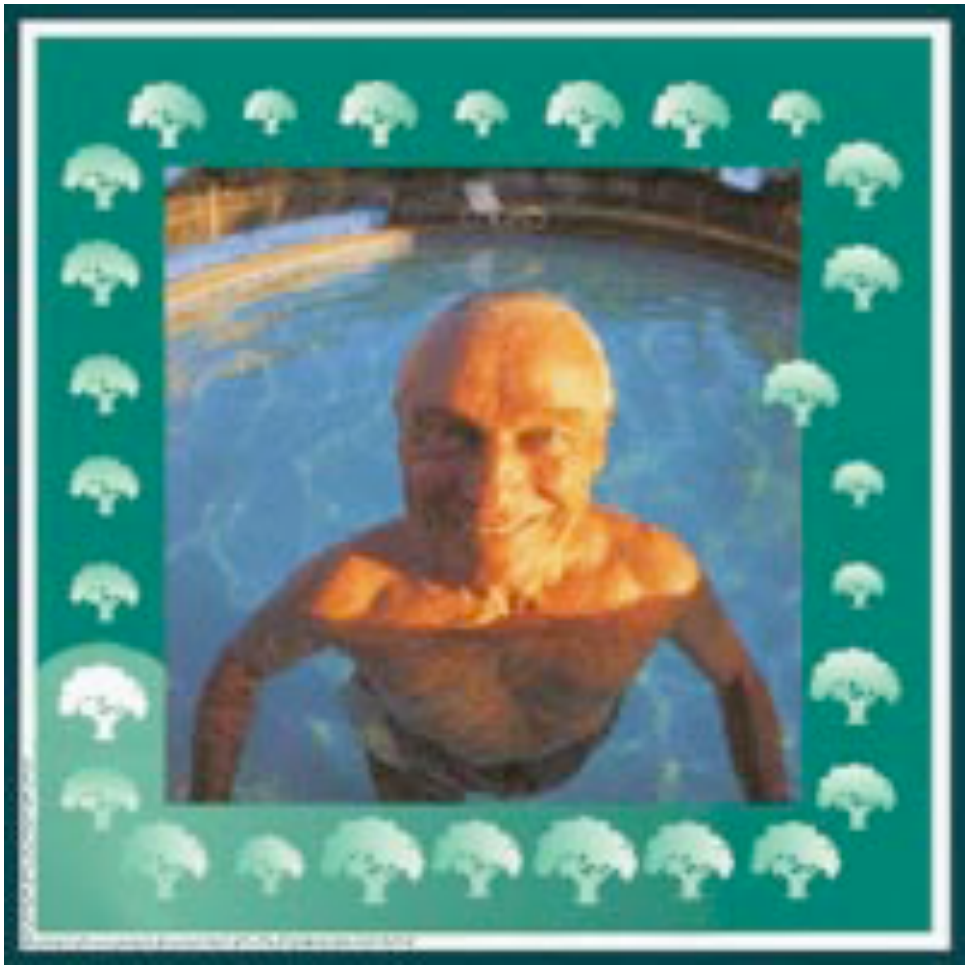


Figure 5
Highlighting Trends and Unusual Days

4.6 Designing for Exploration

Given that the persistent display in the redesign reduces an entire day into a single icon, important details can be obscured. Above I discussed how externally discovered trends could be displayed on the persistent display. While the first design does a similar compression, it does carry more information by the simple fact that four different aspects of daily life are displayed simultaneously. Considering these concerns, it seemed reasonable to expand the design functionally by allowing the user to interact with the persistent display and get a greater level of detail for a particular day of interest. For the redesign, by touching an icon of interest the user can get an expanded view of what took place during that day. Figure 6 is a prototype of what that display could show about the day of interest.

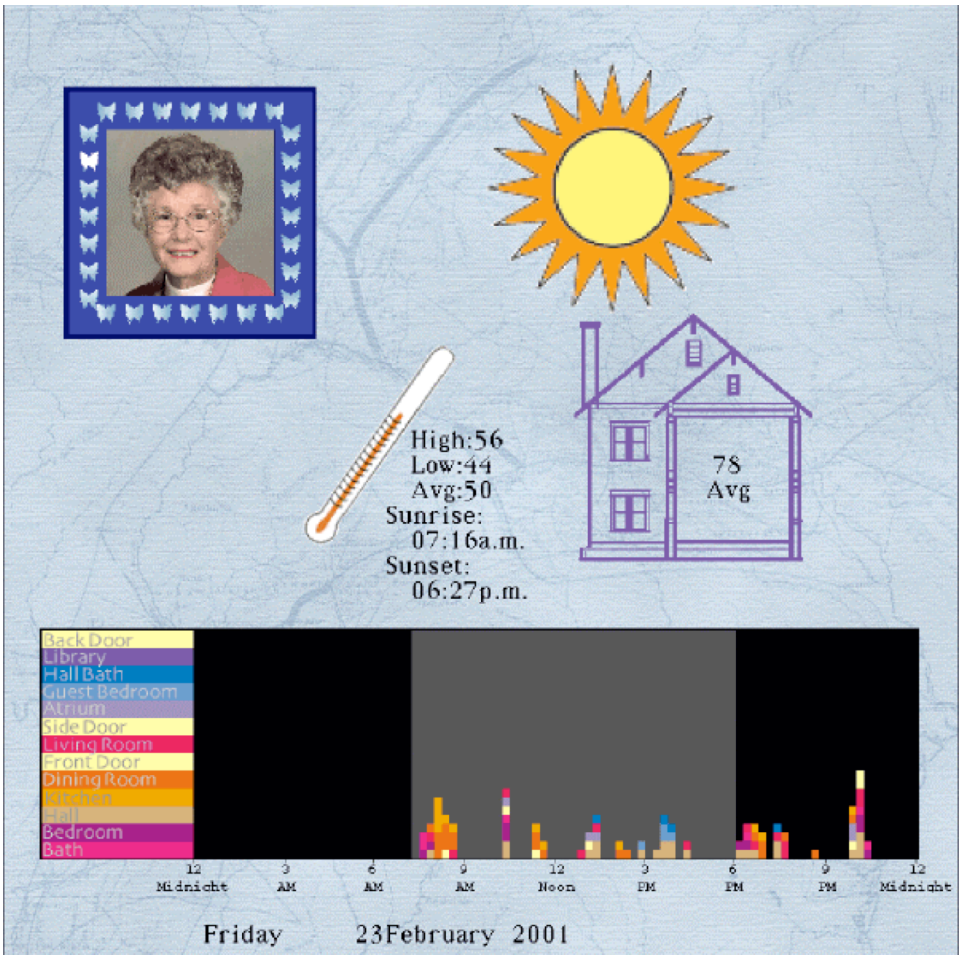


Figure 6
Prototype Detail Display

The context in which activity takes place is important to understanding what that activity means. Since the Digital Family Portrait is meant to support social communication between family members who live at distance from one another, an important piece of context could be the weather. Shown in Figure 6 we see that this day, Friday, February 23, 2001 has been a sunny day with a high of 56 and a low of 44 degrees. Concerns about the proper functioning of heating and cooling systems could be addressed by displaying the average daily indoor temperature.

All the activity that comes together to form the single icon on the persistent display could be given greater detail by showing that activity as it occurs during the day. The display at the bottom in Figure 6 is a prototype of how that could be presented. The day is divided into 96 different 15 minute time periods. All sensor firings that occur during that 15 minutes are totaled and displayed as a bar on a bar graph. In this example we see that there are 13 different areas of interest, the rooms of the house and the exits. These are shown and labeled on the left in different colors. The color bands seen in each of the bars, represent the relative number of sensor firings associated with that particular area of interest during that 15 minute time period. Finally, the sunrise and sunset times, shown in text above the activity chart are reflected in the chart as dark and light backgrounds to highlight the activity that occurs during the day as opposed to the activity that occurs during the night.

4.6.1 Reconsidering the Detail Display

Informal evaluations of the detail display as described above indicated two remaining problems. First, although the bar chart did a reasonable job in summarizing total activity as it occurred through the day, reading the color coded room details to determine where the activity took place was awkward at best. Second, although the display provided more information about the day in question, it did little to help the viewer assess whether these details were typical of a "normal" day.

To address these concerns I modified the bar chart itself to remove the awkward multi-colored room-of-occurrence information and to add a historical context for comparison

purposes. The distinct green bars that replace the multi-colored room-coded bars indicate the total number of sensor firings that occur during a 15 minute period of time. Behind the green activity bars, the blue bars represent a 1 hour running average of the previous four similar days of the week. Since Figure 7 is a detail display for a Monday, the blue bars are the running average of the previous four Mondays. In this attempt to provide some historical context against which to compare the present day, it seemed a reasonable assumption that similar days of the week were more like one another than the immediately previous days, in this case Thursday, Friday, Saturday and Sunday, would be.

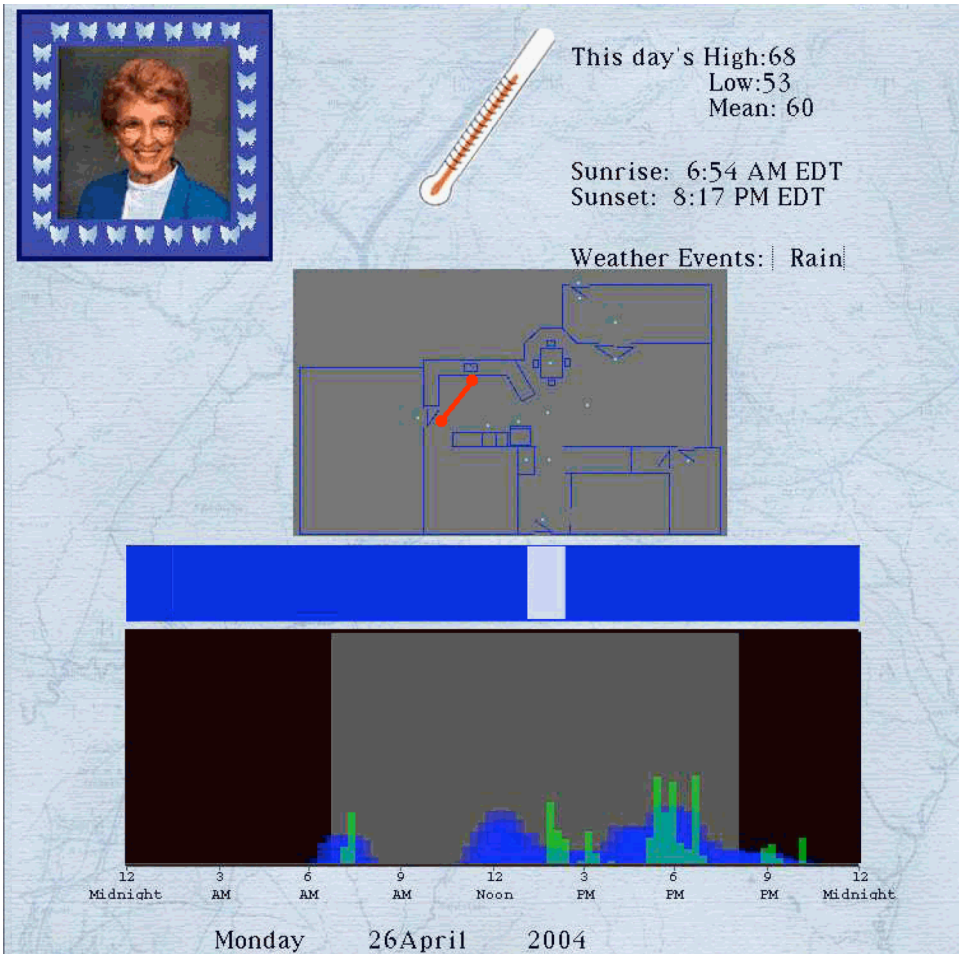


Figure 7
Iteration on the Detail Design

Additionally, I added two design elements to the detail display, a visualization of the floor plan with its sensor layout and a touch interaction slider for data investigation purposes as seen in Figure 7. Working together, the slider and the sensor layout floor plan allows a more in-depth exploration of the activity data that lies beneath the green bars on the activity graph. Moving the slider over the activity chart animates sensors shown in the floor plan above. Figures 8, 9, 10 and 11 show the movement of the slider across four sensor firings that occur in series in a single green bar on the activity graph. Viewing the animation on the floor plan, the single activity bar contains sensor firings that seem to indicate kitchen activity.

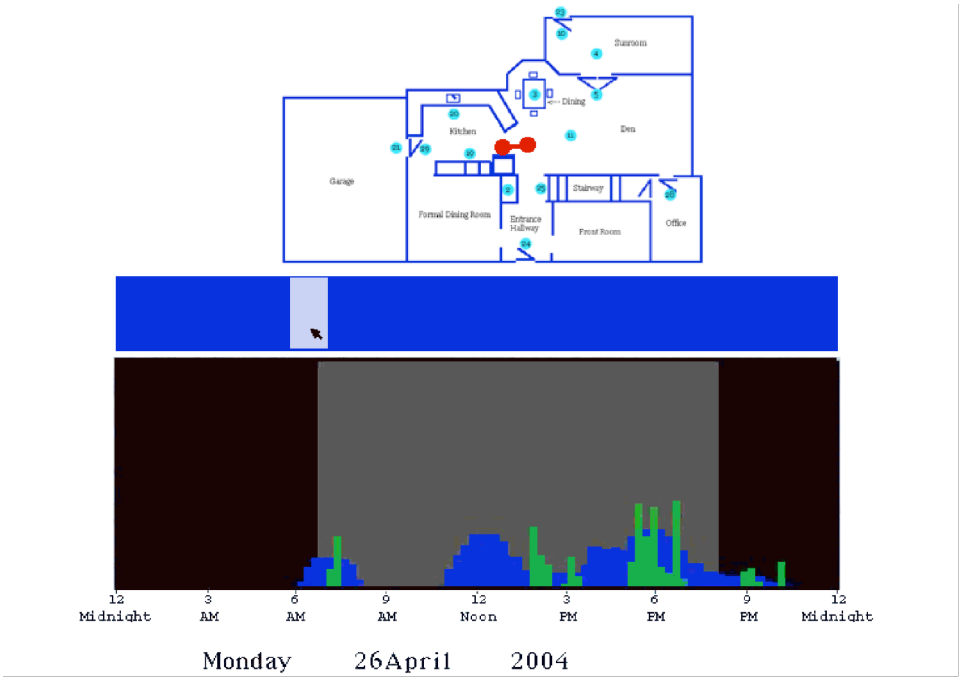


Figure 8
First Sensor Firing

Figure 9
Second Sensor Firing

Figure 10
Third Sensor Firing

Figure 11
Fourth Sensor Firing

A final advantage of this floor plan animation scheme is the ability it provides to investigate parts of the day in which there is no activity. In Figure 12 below the slider has been moved above an area of the activity graph that shows no green bars, that is, an area

were there is no sensed activity. In the floor plan we see that the last sensor to fire before activity in the home ceased was the sensor associated with the back door. From this is reasonable to assume that the person in the home has gone outside into the back yard.

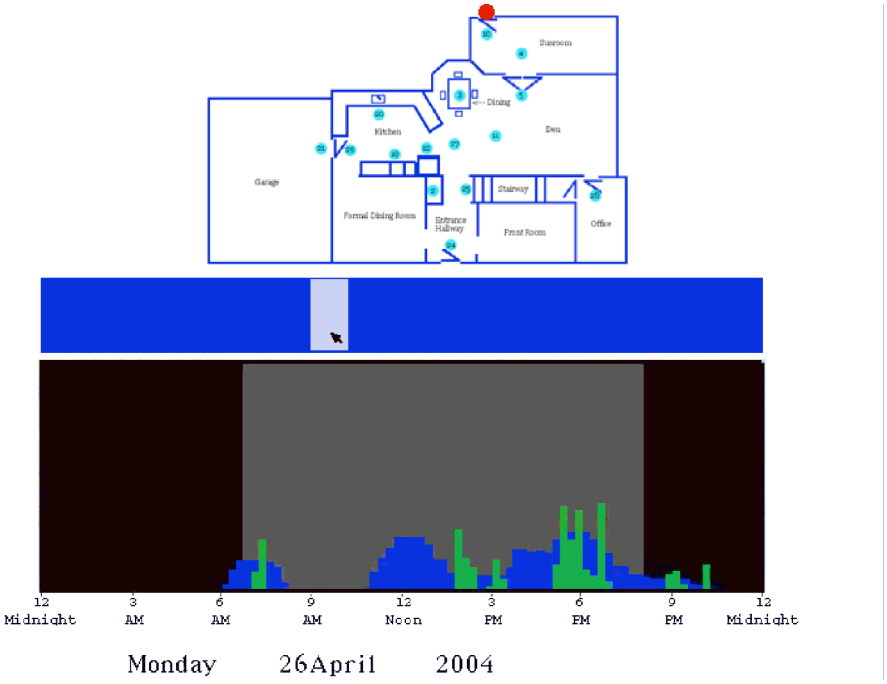


Figure 12
Last Sensor to Fire Before Period of Inactivity

CHAPTER 5

DIGITAL FAMILY PORTRAIT: A YEAR-LONG FIELD TRIAL

5.1 Contribution

The Digital Family Portrait field trial collected data from 15 sensors that were placed in the home of an elder (who I will refer to as Helen, though her name has been changed) for a period of a year. The two participants, who live about an hour's drive away from one another, are Helen whose home was instrumented with the sensors and her adult child (who I will refer to as Will, though his name has been changed) who had the Digital Family Portrait continuously on display in his home. In addition to the sensor data, pre- and post- interviews of both participants were conducted. For the pre- and post- interview guidelines as well as excerpted interview transcripts refer to appendices P through W. During a six week period the participants were asked to keep daily diaries both before and after the Digital Family Portrait was made live in Will's home. These diaries concerned the type and nature of their communications before and after the Digital Family Portrait was turned on. In addition, the participants were asked to rate their feelings of connectedness and awareness. From the collected sensor firing data, the interviews and the daily diaries a number of contributions arose.

Demonstrating that Helen can identify her own periods of activity and inactivity through the viewing of data captured the previous week and then displayed in the form of the Digital Family Portrait is one contribution of this work.

Similarly, representing activity level as icon size did attract Will's attention, resulting in a follow-up phone call to Helen revealing that she had been preparing the house for paint.

The Digital Family Portrait was shown to support Will's feelings of awareness for Helen's well being through a variety of means. The activity display that appears on the detail display was shown to support Will's gross-grained investigation of a day's activity while it failed at the more fine-grained investigation. As previously mentioned, the use of size as a means to attract attention was effective. Finally, the simple fact that the appearance of data for the first time in a day was sufficient to signal Will about an important event, the return of Helen from an extended trip, shows the display's ability to support Will's feelings of awareness.

While the attempt to show that the presence of the Digital Family Portrait increased feelings of connectedness between aging parents and their adult children was stymied by a ceiling effect for Will and by Helen's tying "connectedness" directly to "personal contact", Helen did nonetheless report that the existence of the Digital Family Portrait did make her feel less lonely.

Another contribution of this research is that there is evidence from this field trial that the Digital Family Portrait is a socially acceptable form of technology. First, when Helen was allowed to explore the data that came from her previous week's activities, there were no "Oh my God! I didn't know that Will could tell when I…" revelations uncovered. Also, during the field trial, there was an occasion when the Will noticed what he considered to be an unusually high level of activity. Upon contacting Helen, Will carefully managed the conversation based on previously demonstrated socially acceptable practice and avoided appearing nosey. The fact that the participants continued to use the Digital

Family Portrait after the field trial concluded and the financial support was removed is the final endorsement of the Digital Family Portrait's acceptability.

As with any research that intervenes in a person's work or home life, the research tends to focus the attention of the researchers on individuals. Referred to as the "Hawthorne Effect" this focus of attention by itself creates a positive effect for the intervention. But this positive effect is generally short lived, fading over time to the point that reverting to the way things were before the intervention will again result in a positive effect. While this long term field trial might be subject to the Hawthorne Effect if the term of the research were short, a full year after the research officially ended and monetary support withdrawn, portions of the Digital Family Portrait are still in use.

5.2 Introduction

Despite the intuitive appeal of the redesigned Digital Family Portrait, many questions remain. As described by Intel's CareNet research team in a recent publication:

> *"An important next step is to explore what happens to the acceptance of technologies like the CareNet Display when sensors are introduced to fill the role of human data collectors. Are elders comfortable living in a home filled with sensors? Do care network members trust the data reported by sensors? How is the network affected by sensor or system failure? A fully working system could also enable longitudinal deployments to uncover other unexplored issues. What happens when the technology gets beyond*

*any novelty effects? How are the privacy controls used, and are they sufficient? What social issues do technologies like the CareNet Display introduce to the care network? Do such technologies contribute to a reduction in communications or visits with the elder overtime?"[*CRS04a*]*

From this and from the results of my previous research I judge the important questions that remain to be addressed as:

First, would older adults accept this form of sensing in their homes, and more importantly, would they welcome and rely on the sensing or would they circumvent and game the system? External evidence points to both conclusions. A system such as a home security system can be reassuring, and relied on, especially for someone living alone. However aging adults are often stereotyped as purposefully masking any decline in abilities to avoid outside intervention.

Second, could these systems truly provide useful information to the adult children. What do they need to know about their aging parents? What level of complexity in the sensing is required? The previously mentioned Japanese teapot simply reports its use to an outside party. In contrast, some proposed designs require relatively complex, and potentially erroneous, activity recognition such as recognizing when someone has prepared and consumed a meal.

Third, how would the introduction of such as system affect the relationship between the adult child and the aging parent? The rosy view is characterized as a sense of increased closeness that comes from more awareness and reduced anxiety. A not-so-rosy picture includes an adult child, now armed with third-party information, who doesn't call as often to check in on things, and an aging parent who feels spied on and neglected.

Of course there is no one answer to these questions as each pairing of adult child to aging parent will have different characteristics. Some older adults will require more care and intervention than relatively passive monitoring, and other adults could be so fit as to resent the intrusion. A remaining question is then, what is the "sweet spot," the place where there is a good balance between utility and acceptance or autonomy and intrusiveness, for these types of systems, if one exists?

The purpose of this chapter is to report on a single case study that did turn out to be within this "sweet spot" of utility and acceptance. Despite the quite good health of my older adult, both parties found sufficient utility in the system to continue using it even after I completed the year-long research study and removed financial support for the network connectivity. At one level, this research provides one set of answers to the questions just posed. At another level, it provides a path for subsequent research that aims to explore these questions.

Taking this next step down the methodological trail, this field trial abandons Wizard of oz simulation (Woz) sensing and incorporates the actual deployment of sensing and

display technology in a longer-term field trial. Deploying this sensing technology in a private home over a one-year period to collect sensor activity, this field trial encompasses an intensive 6-week study period and serves as the focus of this chapter.

The contributions in this work then, are three-fold. We assess the feasibility of the Digital Family Portrait as a technology intervention to assist family members concerned about an older parent living alone. As an in-depth case-study, I report on anticipated and unanticipated uses of the system. In particular, this case study focuses on an older adult who is quite independent and although she doesn't seem to "need" external monitoring, she, her adult child, and her extended family nevertheless benefit from use of the system.

5.3 Field Trial Overview

5.3.1 Field Trial Participants

For this field trial I studied two participants, an aging parent who I refer to as Helen and her adult son who I refer to as Will. These participants, while not randomly selected from a participant pool, nevertheless were an excellent match for this first long-term field trial. Will came to me after seeing a presentation on the possibilities presented by the Digital Family Portrait because he found himself in the very position it was designed for. He lives a one hour drive from his mother, Helen, who is living alone in her own home. Helen has lived in the same home, by herself, for the past 20+ years and is in her late 70's. She reports being in good health and still manages and controls all aspects of her life. She drives herself, cooks, cleans, maintains her own home (during the study she was doing touch-up painting) and does her own yard work. Though retired from her career as

a U.S. postmaster, she still works regularly, both inside the home as an editor for a publishing house and outside the home as a volunteer at her church.

Though Helen is still very active and manages all aspects of her life Will expressed concerns about her well-being.

> "Where I'm not concerned on a every day basis of where she is right now and what she might be doing… more along the lines of touching base with her, checking in. If I'm about to leave town… let her know when I'm going to be gone… versus any kind of more concern about her hurting herself of injuring herself or not being able to take care of herself."

This study has four major phases as illustrated in Figure 13. The onset of the study was August 2003 with the deployment of sensors in Helen's home. The sensing technology and layout of sensors is described shortly. Travel by Helen and then the arrival of winter holidays delayed the second phase of the study until February 2004. At this time, I conducted pre-interviews with Helen and Will and requested that they each begin filling out daily diaries. Following an initial two-week period of diary entries, I "turned on" the Digital Family Portrait as the third phase of the study. The daily diary during this phase asked about use of and conversation about the DFP. After four more weeks of daily diaries, I concluded the third phase with post-interviews. The final phase, which began concurrent with phase 3, concluded after I had collected one year of sensor data. As I

will discuss at the end of the paper, Helen and Will still continue to use the DFP of their own volition and at their own expense.

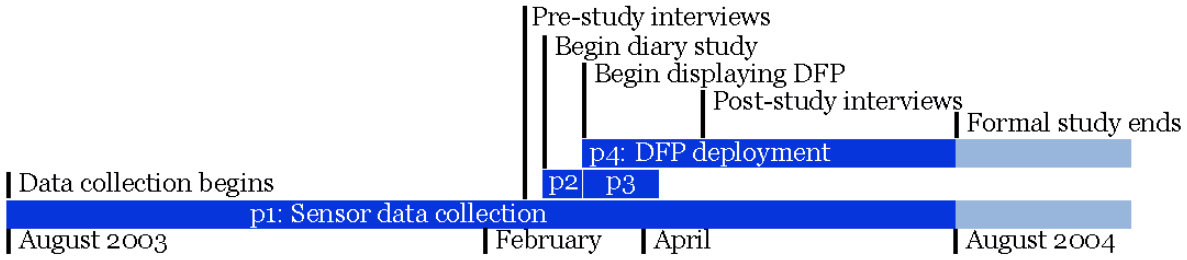


Figure 13
Field Trial Timeline

The pre- and post- interviews with both participants helped to determine the nature of the participants' daily routines, the participants' sense of awareness and feelings of connectedness one to the other, the nature and type of communication that existed prior to the introduction of the DFP, and the effect of the DFP on those communications. The quotes in this paper are pulled from these interviews.

For Helen's daily diary, I asked her to report her overall level of activity for that day, whether most of that activity had occurred in the home, whether she had been in direct communication with Will and if they had discussed the DFP, and her perception of how "connected" she felt to Will. For Will's daily diary, I asked him to report his perception of his mother's overall level of activity, whether he had been in direct communication with her that day, and his perception of his level of "awareness" of his mother as well as his perception of how "connected" he felt to her. Some parts of this diary worked quite well and other parts did not as I will discuss. One helpful addition is that Helen often annotated her diary with a short list of the things that she did that day.

5.3.2 Helen's Social Network

While active in her church, Helen's social network revolves almost entirely around her family, both her siblings and her children. She is the 3rd oldest of 4 children with a brother, in his 80's, living in Illinois, an older sister living in California and a younger sister also living in Illinois. She has 3 children that are also fairly geographically spread with a daughter in Missouri, a daughter in Minneapolis and her son, my participant Will, who lives on the east coast.

Helen keeps in touch with her family through the use of the phone. She calls her oldest sibling, her brother in Illinois, every day at 9pm. On those rare occasions when she cannot reach him by phone she will call her sister, also living in Illinois, to find out if she knows what is going on. She calls her sister in California twice a week on either Wednesday or Thursday and Sunday. She calls her sister in Illinois once or twice a week outside the occasional call to check up on her brother. She sees Will about once or twice a month when he comes to her house to visit, do odd chores and then go to dinner. Though she has lived in the same home for 20+ years she does not rely on her neighbors or her contacts in the neighborhood for her social network. She professes to know her immediate neighbors but apparently rarely has any dealings with them outside the occasional "Hi! How are you today?" pleasantry. She reports

> *"There are days that I don't see anybody. I'm working in here. I don't happen to go to the store, don't go to church for anything."*

When asked if she would mind if neighbors might have access to her daily activities through the DFP, she states that as long as she has family (though they are at some distance) she can't see why the neighbors would be interested in it.

> *"Well, as long as I have a family I wouldn't especially want anybody else to… I don't know anybody that I am close enough to say I would like to have that (a DFP display) or that they would want to have it."*

Though she has frequent contact with her church (she does volunteer work there on Mondays and attends on Sunday and Wednesdays), she does not think that they would be interested in monitoring her activities, so long as she has family available.

5.3.3 Will's Perspective

After hearing a university presentation about this research, Will approached my group about trying out the DFP. As I learned more about his mother, namely about her good health and independence, I was interested in understanding Will's motivation for using the DFP. Based on my interviews, Will does not seem concerned on an everyday basis of where Helen is or what she might be doing at any minute. Neither is he very concerned about the possibility of her hurting herself or about her not being able to care for herself. He is concerned

"… more along the lines of touching base with her… checking in… She used to play some golf but she's cutting back on it… after 18 holes she was real sore… then it got to the point were after 9 holes she was hurting pretty bad so her golf days are declining."

As the child living closest to her, he keeps up with her general activities.

"I'm fairly aware… I know she's doing proof reading and going to church to different functions… I'm aware of when she is traveling to go out to her sister's in California… "

He is also knows that Helen stays in touch with her siblings.

"Religiously… via the telephone… her two sisters she calls or they call her weekly… and she religiously calls her brother at 9 p.m. every night."

The DFP persistent display (Figure 14) presents a qualitative visualization of Helen's daily activity that is designed to fit naturally into a home environment alongside other family pictures on the fireplace mantle. Leveraging a familiar household object, the family picture in a frame, this design leaves the photograph untouched while populating the frame space with icons. Each icon represents a single day's level of activity for the 27 previous days and the current day. The previous day's icons provide a history of past conditions while the current day is updated hourly to represent the current conditions.

Figure 14
Persistent Display of the Digital Family Portrait

The viewer can acquire more detail concerning the level of activity for each of the days represented in the frame by touching the icon in question. The DFP detail display (Figure 15) presents important context information, such as the weather conditions for that day, the sunrise and sunset for that day, a floor plan of Helen's home showing the sensor locations and includes a slider for exploring the detailed information. Located at the bottom of the detail display is an activity graph.

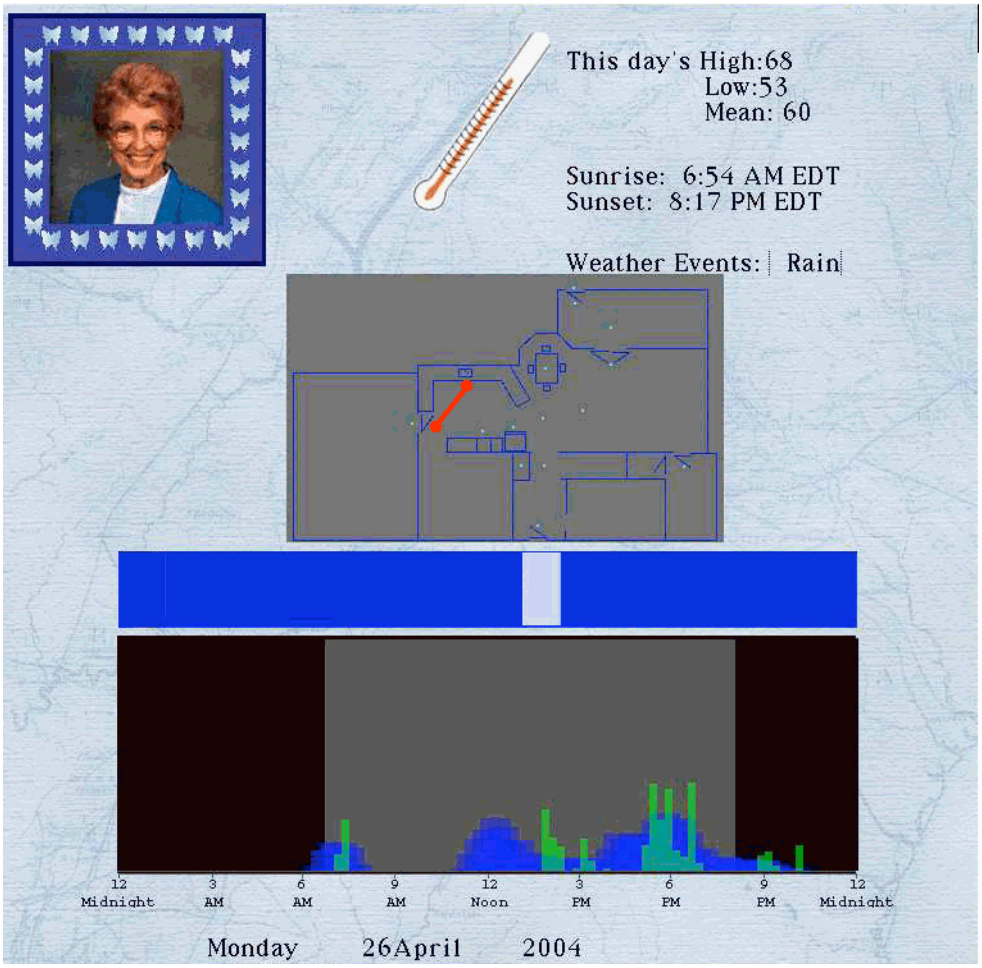


Figure 15
Detail Display of the Digital Family Portrait

The activity graph takes the 24 hour day, divides it into 96 fifteen-minute time periods, and displays the number of sensor firings (regardless of which sensor fired) as a bar graph. The graph of the current day (in green) is displayed over a one-hour running average of the sensor firings for three previous similar days (in blue). In this way, the activity graph shows what has happened that day against the backdrop of what typically happens on that day.

By dragging the slider across the top of the activity graph, the floor plan is animated to show sensor firings as they occurred that day. As pictured here, Helen has come back from shopping, and the display shows her most recent movement (shown as a red trace on Figure 15) from inside the garage door to the kitchen sink as a trace from one sensor to the other.

5.3.4 Sensing Technology

To unobtrusively collect activity data, I installed sensors in Helen's home that did not require her to modify her habits in any way. I installed these sensors in the crawlspace of the house, attached to the exposed floor joists, in a manner that is completely invisible to anyone in the house.

I chose a commercial sensor product called Pulsors [Sur05] that is built on the simple strain gauge and includes an electronic controller that converts the strain gauges' analog resistance change into the equivalent of a relay switch closing. While the strain gauge is an inherently analog device providing an electrical resistance change as it is bent, the electronic controller for the strain gauge has set and trip points that convert the resistance into a digital signal, either tripped or untripped, either 0 or 1. The strain gauge is encapsulated in a plastic case that is easily attached to the floor joist (from the crawlspace) using an epoxy glue. Wires from the gauges go back to the controller. Each controller can handle four sensors. To interface the controllers to a computer I used a 32 port PhidgetInterfaceKit 0/16/16 board [Phi05b]. This board allows the sensor firings

coming from the controllers to be read into a computer for identification, time-stamping and storage through a single USB connector.

Although many sensor options are available ranging from wearable RFID tags, to wireless motion detectors, to the sensors I used in this study, I opted for these sensors because they did not require any active use by Helen, they would provide relatively clean and reliable signals, and they would not be physically or aesthetically obtrusive in the home. I acknowledge that difficult privacy issues come into play with invisible sensing, for example, for visitors to Helen's home. However, given the low occurrence of such visitors, my concerns about invading Helen's home, and the low level of information provided by the sensors, I opted to pursue this path.

5.3.5 Sensor Layout

The monitored area of Helen's home includes a kitchen, a dining area, a hallway, a den, a sunroom and an office area (see Figure 16). Even though I was only interested in collecting gross activity by totaling sensor firings, I felt it was important to arrange the sensors logically so that the collected data could be used in future activity characterization. The question is, with an upper limit of 16 sensors (our sensor budget), where to best place them?

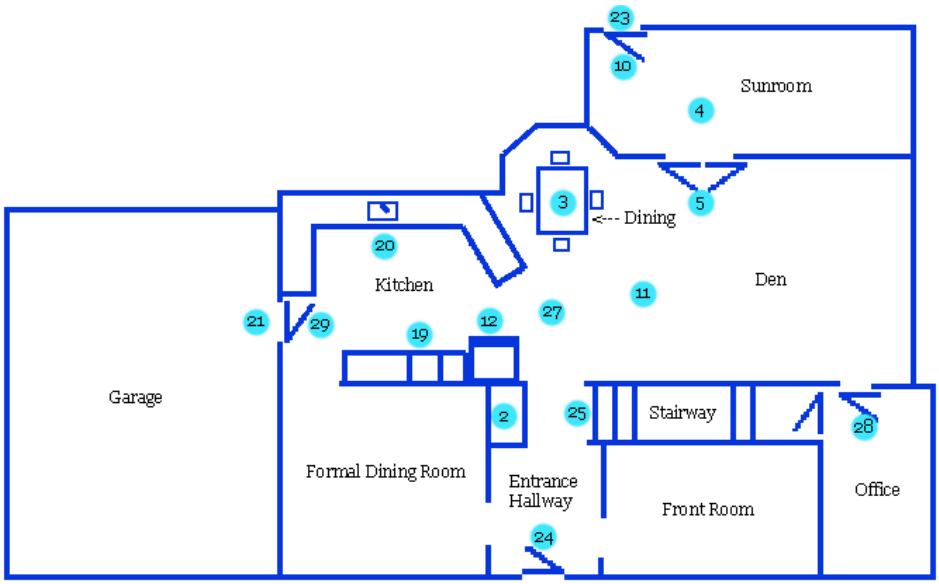


Figure 16
Sensor Layout in Helen's Home

Clearly it is important to cover all exits so sensors 21 and 29 were placed at the garage door, sensors 23 and 10 were placed at the back door and sensor 24 was placed at the front door. While I thought it important to capture Helen's presence at the door both on the inside and the outside of the house, the concrete front porch made capturing her presence outside the front door impossible. When there is no movement in the house, sensor firings at exits distinguish between a possible problem (Helen is at home but is not moving) and Helen having left the house since no movement in the house with the display showing sensor 21, 23 or 24 as the last sensor to fire clearly denotes her having left the house.

A second place of general interest is the kitchen since meal preparation is important so sensors 12, 19 and 20 were placed at the refrigerator, at the stove and at the sink respectively. By placing sensors in front of the sink, the refrigerator and the stove, I cover

the classic kitchen triangle. Extending meal preparation to include the actual dining, sensors 27 and 3 were placed to catch movement to and from the dining table.

The sensor at the bottom of the stairs, sensor 25, not only indicates passage from one area to another, it indicates that Helen has gone upstairs to her bedroom suite. Placing it here forces this sensor to be the last to fire at the end of the day and the first to fire at the beginning of the next day. There is a sensor attached to the alarm system, sensor 2, that is set when Helen arms the alarm system.

The remaining sensors, numbers 4, 5. 11 and 28 cover passage from one room to the next. Given Helen's good health and limitations of my sensing technology, I did not install sensors in her upstairs bedroom or bath. As it turned out, Will would check for the first sensor firing at the bottom of the stairs, sensor 25, as a simple indication that the night had passed well.

5.4 How the DFP Was Used

5.4.1 Field Trial Results

One set of questions for this field trial revolve around how the adult child (Will) used the DFP display and interface as a representation of his mother's activity. At the simplest level, the DFP provides two major affordances. The first is the ambient, persistent display of the picture framed by the butterfly icons. The second, the interactive "detail" screen, requires active input and supports rudimentary browsing of the sensing data. I organize my findings based on these affordances

5.4.2 Investigation Prompted by the Persistent Display

The DFP display in Will's home is located in the den, adjacent to the kitchen, a place where it is readily visible as Will leaves for and returns from work. In interviews, Will reported checking the display to see if anything looked out of the ordinary as he leaves the house in the morning and as he returns in the evening.

For example, curious about the appearance of a large icon for a particular day Will called his mom to try to determine what had happened that day without specifically mentioning that there was a large icon for that day.

> *"…to see if she volunteered any change of activity pattern… I found that she had washed the walls and was getting ready to paint… she was moving around a lot more and had obviously tripped the meter a few more times… the butterfly [icon] got big."*

It is interesting to note that Will did not call his mother to question her about a large reading on the DFP display. The DFP information was the catalyst for the phone call, but Will let the information come out naturally. This kind of subtlety may be important for the acceptance of a DFP-style monitoring system and its integration into existing social protocols.

5.4.3 Investigations Prompted by Will's Curiosity

The detail screen of the DFP encourages different ways to explore the sensor data. One interface failure points to Will's motivation for understanding his mom's daily activity. The detailed display for a particular day includes a bar graph display, a floor plan of the house and a slider that, when dragged through the 24 hour day, animates the sensor firings on the floor plan. About using the slider Will stated

"…I was trying to get a feel for how she was moving around the house…"

Unfortunately the volume of the data coupled with the difficulties involved with moving the slider by hand made this prospective use unfeasible for this field trial. Future versions of the DFP interface will create sensor "trails" that persist for a portion of the day and slowly fade away.

For this field trial I took advantage of an existing alarm system in the home. As it happens, the alarm system could be used to signal my sensing infrastructure in the same way that a sensor would trigger it. Knowing that his mom didn't set the alarm on her home unless she was going to be away for a while, Will could investigate a displayed period of absence. He could differentiate between leaving the home for an extended period, shown by the "alarm sensor" firing followed by an exit into the garage, and leaving the home to do yard work, shown by the an exit into the garage to get the lawn mower without the "alarm sensor".

"In several cases I would go look to see if she had armed the alarm system or not because that would tell me that she was planning to be gone for a while… as opposed to going out to get the newspaper or cut the grass. So I could kind of tell."

His mother returning from extended travel is anxiety producing for Will. His typical plan is to repeatedly call her house after her expected return time although he dislikes intruding on her before she has settled back in. Having used the activity data collected by the DFP to determine that his mom had returned safely from her three week trip to California, Will stated

"Yeah, when she's traveling, I tend to worry a little more that something could happen… when I know that there is a risk of something travel related… I'm a little more aware of where she ought to be at a certain time and I will try to check in. One of the advantages of [the DFP] to me is to be able to resolve little concerns like that before they turn into undue anxiety over what's going on… Your paranoia's going to take over if you don't. "

"… I was intending to call her about something when she got back… rather than calling and getting her answering machine, [once data started arriving from her home] I had a pretty good clue that she had been there… she actually got back sooner than I expected so that was a kind of pleasant thing."

5.4.4 Awareness and Connectedness

Another set of questions for this field trial revolve around the dynamics of the parent and adult child relationship. In my view, awareness and connectedness are closely associated with one another and should therefore be teased apart. Awareness has a remote-sensing, at-a-distance, one-way feeling to it. Connectedness on the other hand has an emotional element to it. It has a two-way, interactive, inter-personal feeling that awareness lacks. Table 8 below helps tease apart different aspects of awareness and connectedness through examples.

Table 8
Examples of High and Low Feelings of Awareness/Connectedness

	Awareness low	Awareness high
Connectedness low	An adult child is separated and cut off from the aging parent without the benefit of knowing their parent's comings and goings. Additionally they feel disconnected from their parent's lives with little personal contact.	A nosy neighbor can keep an adult child aware of an aging parent's comings and goings but the adult child would not necessarily feel connected to the aging parent.
Connectedness high	A regular weekly phone call can help an adult child feel connected to an aging parent but does little to inform them concerning their parent's daily comings and goings	DFP By providing daily indications of level of activity as well as access to greater detail of daily activity, awareness of an aging parent is kept high. Feelings of connectedness are supported by providing context for observed activity. Additionally, the persistent presence of an aging parent's activity can foster other forms of social communication such as an unplanned phone call.

I hypothesized that two characteristics of the relationship, awareness and connectedness, would change although not necessarily in a positive direction. First, I assumed that the adult child's "awareness" of his parent's activities would increase simply by providing more information. I also expected that feelings of emotional "connectedness" between both parties would increase given this technological bridge. However, I acknowledged that connectedness could potentially decrease on the part of the older adult who perhaps

feels more isolated if the adult child shifts the burden of maintaining an emotional connection too heavily on the DFP bridge.

Where awareness is more based on facts (e.g. "I know Mom goes shopping on Thursdays"), a kind of familiarity with another's schedule, connectedness is more intimate, an emotional state of co-existence. Awareness can lead to feelings of connectedness, though it is not necessarily a precedent to connectedness. Photographs on a mantle are more about feelings of connectedness than they are about awareness. They provide emotional support as reminders of social and familial connections, and provide a feeling of comfort.

I attempted to measure changes of perceived awareness and connectedness by asking Helen and Will to rank these indicators using a Likert scale daily in their diary. This measurement technique did not produce any useful results. With Will, I simply saw a ceiling effect as his self-reported ratings of awareness and connectedness started high before I activated the DFP interface. With Helen, it is clear from an examination of the data that she closely tied connectedness to whether she talked with Will on the phone that day. Since the frequency of phone calls did not noticeably change, there was no shift in connectedness based on the presence of the DFP. However, interviews with Helen are more revealing.

In a manner similar to the photograph on the mantle, even though there is no physical manifestation of the DFP in her home, Helen reported feeling less lonely (and therefore

more connected to her family) knowing that Will was watching out for her through the DFP.

> *"But, uh… if I'm feeling lonesome, I think, "Oh well, Will knows and so then I don't feel so lonesome.'"*

Her statements initially surprised me as there is no physical reminder of the DFP system visible in her home. However the knowledge of the system, and likely the successful practice of having the system connect them appears to have significantly affected Helen's emotional response to being alone in her home.

5.4.5 Privacy and (Traditional) Security

Our final set of questions revolve around the cost and benefits tradeoffs, especially for the older adults, in assessing that the DFP system is of sufficient value to warrant adoption. In particular I want to understand the perceived privacy costs in comparison to the advantages gained from knowing that someone has more information about your general activity and well-being. I refer to this benefit as "security," not in the sense of information security, but akin to the traditional use of that word, feeling safe from harm.

The invisibility of my sensor technology initially arouses concerns about privacy. After all, if Helen forgets that she is being monitored because the monitoring technology is invisible, then she loses a level of privacy that most people like to maintain. I did not find this lack of a persistent reminder to be a concern for Helen. Generally speaking in my

research, older adults are concerned about maintaining a careful balance between privacy and autonomy. While both are important, aging often necessitates some compromise. Giving up some privacy in order to maintain autonomy is a valid choice, the question is "How much privacy must be given up in order to maintain autonomy?" There is, however, a limit to how much and what type of sensor technology provides the correct balance. During the interview Helen stated

> *"Will talked at one time about having cameras up in the corners and I wasn't too keen on that… I just didn't know that I wanted a camera watching me."*

Our approach is to opt for sensing that does not distinguish between occupants. It is possible to use this type of sensing in this research because Helen lives alone in her own home and has few outside visitors. The sensing technology has the advantage of not requiring any active participation in the sensing system on the part of the Helen; there were no badges that must be worn or sensors that must be carried. All the participant need do is to live her life as she would normally.

The exit interview suggests that I selected a sensor technology that supports a reasonable balance between privacy and autonomy.

"…I would say that I feel more comfortable knowing that he knows that I'm moving around. He knows that there's something going on down here. And if he doesn't get something with a malfunction, he calls."

Even though the sensor technology is invisible to the participant, Helen appears to draw comfort from the knowledge that her son is monitoring her activity. Surprisingly, the occasional malfunction of the equipment causes her confidence to increase in the system. Since a malfunction cannot be distinguished from no activity, Will made a phone call to check. This phone call acted as a system test to Helen, demonstrating that the system is indeed being monitored.

Additionally, the choice of sensing technology that does not identify the person reduces the privacy concerns that arise when a third party, not knowing that monitoring is going on in the home, enters the monitored space since the third party is not identified or distinguished from the participant.

Helen's overall position about having this sensing technology deployed in her home can be summed up by her comment

"I don't feel imposed upon, or spied upon or anything."

Another indication of perceived value came from Helen volunteering that she wished that she had the DFP when her mother was alive.

"I wish it had been available when my mother was living and I lived in all these other towns while she was back in Illinois. (Helen's job as a postmaster moved her from town to town, predominantly in the mid-west). It would have been nice because she lived alone for 25 years and went down hill over that period of time. It would have been nice to know that she was up and around and moving but…That's when I called her. The telephone got of use…"

Helen and her siblings had set up an ad hoc phone call system to keep up with their mother.

"We set up a system over the last years of her life where I called twice a week. Somebody else (one of the other of the 3 siblings) called twice a week and then somebody else called twice a week… so we covered 6 days and we all called on Sunday… Or at least we all were supposed to call her on Sunday. Sometimes we did and sometimes we didn't. We tried to set that up so that somebody talked to her every day. It's kinda hard cause I was working…"

Will's Perspective on Level of Intrusiveness Needed

If the sensing system is acceptable to Helen, then the subsequent question is whether the information provided by the system is of sufficient utility for Will. Will reports

"At this stage I'm loosely connected as opposed to intimately aware of what's going on. I don't think I need to be in her life, intruding in that respect… I imagine that I will be more aware as time goes on… but for right now I think we are at what I consider the right level."

5.4.6 Value for the Extended Family

Although I did not interview Helen's other children or her siblings, I was pleasantly surprised to hear Helen report that other family members were interested in the system:

" …(my daughter in Missouri)… I can't remember why but she was very interested in it (the DFP field trial). She was very pleased that we were doing it . It puts her mind at ease… even though it is not her (participating in the field trial), she knows it's in place."

5.5 Proposal Hypotheses and the Field Trial

The following five tables, Tables 9-13, are a comparison of the five different hypotheses as envisioned at the time of my research proposal. The columns making up the tables starting from the left include a label of the relevant parts, the hypothesis, the relevant data, the analysis technique to be used, the expected result, the potential contribution that this represents and the evidence garnered from the during this field trial. The next column is the hypothesis as stated at my proposal and one to four columns which show the evidence found during the field trial that supports the hypothesis. In Tables 9 & 10 there is a one to one correspondence between the proposed hypothesis and the evidence found

to support that hypothesis. In Tables 11 & 12 the hypothesis as stated was too complex to directly support with evidence from the field trial so it was broken out into three constituent parts, parts A, B and C. The last table, Table13, has evidence from the field trial broken into four constituent parts, parts A, B, C and D.

Table 9
Hypothesis 1

	Hypothesis as Proposed	**Hypothesis as Supported**
Hypothesis	An aging adult's perceived/reported activity level is correlated with sensor data collected in their home	**Sensor data displayed as an activity display can be correlated with actual activity**
Relevant Data	Aging adult Likert scale daily ratings of level of activity Sensor data	**Collected data used for post-experimental data "drive through"**
Analysis	Development of descriptive statistics concerning sensor-detected activity in the home and collected activity self-ratings	**Can the aging adult identify their own activity during the week?**
Expected Result	The sensor data and the perceived/reported data are correlated and can be characterized by descriptive statistics	**The aging adult can identify certain aspects of their behavior from the detailed display of the data**
Potential Contribution	Demonstrate a relationship of collected sensor data to self-reported levels of daily activity	**The data collected and displayed supports understanding activity**
Evidence		**The aging adult can identify their activity from the detail display of data**

Table 10
Hypothesis 2

	Hypothesis as Proposed	**Hypothesis as Supported**
Hypothesis	An adult child's interpretation of the activity level portrayed by the digital family portrait correlates with the aging parent's perceived/reported activity level	**Activity level displayed as icon size correlates to aging parent's perceived activity level**
Relevant Data	Adult child Likert scale daily ratings of level of activity as seen in the DFP Aging adult Likert scale daily ratings of level of activity	**Displayed icon size**
Analysis	Development of descriptive statistics concerning sensor-detected activity in the home and collected activity self-ratings	**Aging parent's anecdote**
Expected Result	The adult child's interpretation of the DFP is correlated with the aging adult's perrceived/reported activity level	**Activity level correlates to aging parent's perceived activity level**
Potential Contribution	Demonstrate that the DFP can effectively visualize sensor data.	**Iconic representations are effective visualizations of sensor data**
Evidence		**Adult child notices large icon, contacts aging parent to discover that she was cleaning in preparation of painting**

Table 11
Hypothesis 3

	Hypothesis as Proposed	A	B	C
Hypothesis	The DFP supports an adult child's feelings of awareness of an aging parent's well being	**Well-being awareness supported by providing support for investigation of activity data**	**Awareness of well-being supported through availability of persistent display**	**Awareness of well-being supported through availability of persistent display**
Relevant Data	Daily survey. Pre- and Post experimental interview. Likert scale of feelings of awareness	**Post-experimental interview**	**Post-experimental interview**	**Post-experimental interview**
Analysis	Self-reported awareness. Interpret/analyze interview data clustering & anecdotes	**anecdote**	**anecdote**	**anecdote**
Expected Result	Using the DFP, the adult child expresses an increased awareness of the aging parent's well being	**adult child can navigate data in detail display to understand aging parent's day**	**adult child can recognize unusual situations in their parent's home**	**adult child can assess conditions at aging parent's home on return from trip**
Potential Contribution	DFP supports an adult child's awareness of an aging parent's well-being	**DFP supports an adult child's awareness of an aging parent's well-being**	**DFP supports an adult child's awareness of an aging parent's well-being**	**DFP supports an adult child's awareness of an aging parent's well-being**
Result	**Yes- detailed display used to investigate gross behavior like the meaning of "no activity" No- display cannot be used to investigate fine grained behavior like kitchen behavior**		**large butterfly displayed & noticed, prompting phone call to mom**	**arrival of sensor firings indicates the parent's return from trip**

Table 12
Hypothesis 4

	Hypothesis as Proposed	**A**	**B**	**C**
Hypothesis	DFP increases feelings of connectedness between the aging adult and their adult child	**DFP increases feelings of connectedness from the adult child's perspective**	**DFP increases feelings of connectedness from the aging parent's perspective**	**DFP increases feelings of connectedness from the aging parent's perspective**
Relevant Data	Weekly survey. Pre- and Post interview. Likert scale of feelings of connectedness	**Likert scale**	**Likert scale**	**post-experimental interview**
Analysis	Self-reported ratings of connectedness Interpretation & analysis of interview data; clustering and anecdotes.	**View Likert scale**	**View Likert scale**	**anecdote**
Expected Result	Feelings of connectedness increase with the presence of DFP for both the adult child and the aging adult.	**connectedness increases with use**	**connectedness increases with use**	**Participant expresses increased connectedness**
Potential Contribution	Demonstrate that DFP supports adult child's and aging parent's feelings of connectedness	**Demonstrate that the DFP supports the adult child's feelings of connectedness**	**Demonstrate that the DFP supports the aging parent's feelings of connectedness**	**Demonstrate that the DFP supports the aging parent's feelings of connectedness**
Evidence		**No- Ceiling effect for adult child**	**No-direct mapping to personal contact for aging parent**	**Yes- aging parent reported feeling less lonely**

Table 13
Hypothesis 5

	Hypothesis as Proposed	**A**	**B**	**C**	**D**
Hypothesis	DFP is socially acceptable technology	**Socially acceptable w/r/t privacy issues**	**Socially acceptable w/r/t privacy issues**	**Socially appropriate usage**	**Socially appropriate technology**
Relevant Data	Pre- & post-interviews Daily journal entries Sensor data	**"driving" elder through data for previous week**	**pre-interview**	**post-interview**	**post-interview**
Analysis	Descriptive statistics unusual patterns, odd days, outliers & show stoppers	**search for anecdotes, show stoppers**	**search for anecdotes, show stoppers**	**search for anecdote**	**search for anecdote**
Expected Result	DFP is minimally intrusive and is socially acceptable technology	**minimally intrusive**	**minimally intrusive**	**appropriate use therefore socially acceptable**	**socially acceptable**
Potential Contri-bution	Demonstrate that the DFP is socially acceptable technology.	**socially acceptable**	**socially acceptable**	**socially acceptable**	**socially acceptable**
Evidence		**There were no "Oh my God!" revelations during the "drive"**	**Limit to privacy invasion (concerning use of camera sensors) not exceeded**	**Phone conversation managed & based on socially acceptable norms (not nosey)**	**DFP remained in use after financial support was removed**

5.6 Conclusions

The core research question for this study is: Would a family find sufficient value in the DFP's ability to convey the general activity of an older adult to her adult child for them to successfully adopt the system? The fact that Helen and Will continue to use this system today, over a year after its deployment, is quite encouraging. Will both used the DFP in anticipated and unanticipated ways such as noticing surprising activity readings, inferring when Helen was out doing errands, and monitoring her return from travel. As the proponent for this technological intervention, he adeptly leveraged this new information without causing undue concern or discomfort for his mother.

Helen's acceptance and emotional reliance on the system is both a little surprising and encouraging. Her volunteering that the DFP made her feel "less lonely" and that she wished the DFP had been available when her mother was alive was unexpected.
Of course this study involves only one family. However, the success of the system with an older adult as healthy as Helen is an indication that the potential space of possible users may be larger than initially anticipated. In my future research, I will investigate the utility of a DFP-like system for older adults who have more significant health concerns.

CHAPTER 6

SENSING DAILY LIFE

6.1 Contributions

When interviewed, the adult children of aging parents express concerns that they have about allowing their parents to continue aging in place. Common examples from interviews include "Is she eating regularly?", "Is he exercising frequently?", "Is she sleeping well?" to name a few. The Digital Family Portrait research is about providing peace of mind through the use of sensing placed in the home of the aging parent and its display in the home of the adult child. But the problem is that there is no "Your father is sleeping well" sensor available on the market.

In this chapter I first introduce a hierarchy that can be used to think about how to translate the high level of concerns as expressed by the adult children into the low level of physical sensors that can be placed in the home. This is followed by a comparison of 3 different home sensing systems considered for the Digital Family Portrait against criteria that are important for home sensing systems intended for installation in the homes of the elderly. These criteria include privacy issues, issues of human dignity as well as installation and retrofit suitability, believability and the affects of sensor maintenance.

6.2 Mapping Concerns to Sensors

Given that the lack of peace of mind can have this negative effect on an elder's ability to age in place, my research question is "How does one support peace of mind for the adult child, given that distance deprives them of the casual, opportunistic, day to day contact?" To answer this question I need to take what the adult child wants to know, i.e. how their

parents are doing on a day-to-day basis, and somehow translate that into devices that actually sense things in the physical world of the aging parent and then display that in a form factor appropriate for use in the home of the adult child.

One large question in the design of the DFP is "How does one sense things in the real, physical world and translate those physical measurements into something that the adult child can use to allay concerns about an elder living alone?" In trying to determine if Mom is doing well enough to allow her to remain in the family home, I find that the questions asked by adult children are expressed as concerns such as "Is Mom sleeping well?" or "Is Mom eating well?" Clearly there is no "Mom is sleeping well" or "Mom is eating well" sensor, so how does one make the translation from their high level concerns (health sleeping, eating, exercise) down to concrete, low-level sensors that measure the actual physical environment?

We found it useful to think of this translation as a hierarchy, starting at the highest level, that of the adult child's *Concerns*. Below *Concerns* I found it useful to have three lower levels starting with *Characteristics*, then *Indicators* and finally arriving at the lowest level, *Sensors*.

6.1.1 Concerns

In interviews, adult children express concerns about an parent's health, emotional well-being and level of social interaction as questions like "Is Mom sleeping well?" "Is Mom eating regularly?" or "Is Mom getting enough exercise?" These are their concerns and

they are highly individualized, varying from person to person. For some, there are concerns about mobility issues, where for others there are concerns about sleeping habits or kitchen practices.

6.1.2 Characteristics

To answer the questions posed as concerns, I have to consider what things come together to characterize “sleeping well” or “eating regularly.” Again, this can be highly individualized. It might be that a period of relative inactivity during certain hours of the night that characterizes “sleeping well” while a period of relative high activity during certain hours of the night characterizes “sleeping poorly”. Alternatively, it may be that moving from the bedroom to the bathroom fewer than a certain number of times during the night that characterizes “sleeping well.”

6.1.3 Indicators

There can be a number of different indicators for a particular characterization of a concern. For instance, if I am characterizing “sleeping well” as “fewer than two trips to the bathroom”, the indicator of this could be either bursts of activity separated by periods of inactivity in the bedroom at night. Another indicator that can be used to characterize “sleeping well” could be keeping a count of the number of bedroom to bathroom transitions that occur during the night.

6.1.4 Sensors

At the lowest level of my hierarchy are the sensors, the actual devices that do the physical measurement of the environment. Sensors inform the indicators of particular characteristics that, in turn, address the adult child's concerns. There are a number of sensors that are appropriate for use in the home environment. Each of these have differing levels of appropriateness and invasiveness as well as different advantages and disadvantages. Additionally, the choice of sensor depends on how well the sensor matches the indicator that it is informing. For example, if "sleeping well" is characterized as fewer than two trips to the bathroom during the night, an X10 motion sensor aimed down from the bathroom door to catch movement through that door would match nicely.

Given the above approach to mapping sensors to the concerns of adult children, what sensors are available for use in the home environment and how does one compare those sensors? What criteria affect these sensor's applicability and suitability?

6.2 Sensor Selection for Aging in Place

While there are a large number of different sensing technologies, some of which are robust and well established, others are currently being researched, for the 2003-2004 field trial I considered three different types of technology, RFID, X10 Wireless Motion Detectors and Strain Gage based sensors. There is discussion of these sensors in an elder's home in terms of the possibility of the sensing system having a stigmatizing effect on the elder as well as discussion of practical installation and maintenance issues.

6.2.1 Radio Frequency IDentification (RFID)

RFID sensing technology is a wireless technology that consists of two basic parts, a transmitter/receiver and an RFID tag the size of a grain of rice. The transmitter/receiver is connected through a control box to a computer so that events can be captured, time-stamped and logged. Since each RFID tag has a unique ID, anything with one of these tags can be tracked as it passes various transmitter/receivers.

The RFID tag is actually a small computer that derives its power from the radio frequency transmitted by the antennae. Once the tag is close enough to the antennae to produce enough power to "boot" the computer in the tag, the tag transmits its unique identification number, which is received by the antennae and then shuttled to a computer for time stamping and storage. The tag shuts down after a transmission.
The antennae/transmitter is flat and similar in size to a table placemat. One must consider the physical difficulties presented by the placement of this antennae as well as the wiring required to connect it through their controllers back to the logging computer. The antennae can be arranged under or built into rugs or mats and placed about the home but each of these mats must still be wired back to their logging computer.

If installation were to occur during home construction, the wiring and antennae could be built into the walls and floors as construction proceeds. But for aging in place purposes I must assume that the house exists since my point is to allow an aging parent to age in place. For this reason I must consider what it means to install the antennae and the wiring in an existing home. Such an installation will be intrusive since either the walls will have

to be disturbed to hide wires in them or the wires will be visible on the outside of the walls.

With the RFID tag system, the thing to be tracked must have an RFID tag associated with it. For consumer products or for tracking cattle in a herd this is not a problem since the tag can either be built into the product packaging or, in the case of livestock, it can be placed under the skin. Given this, for tracking individuals as they move about in their own homes the occupant must wear or carry something that contains the RFID tag. This requirement is problematic for numerous reasons. First, the system will not work if the RFID is misplaced, not worn during certain times of the day or simply forgotten. Second, wearing or carrying a device for identification purposes has a stigmatizing effect on the person carrying it [RCS04b]. Finally, having to remember to wear or carry an RFID tag is a constant reminder of a person's frailty.

6.1.2 X10 Wireless Motion Detectors

Another technology that is available for use in the home is the X10 wireless motion detector. Where all motion detectors can detect motion within their operating range, wiring them back to a central location is a problem for existing homes and present the same kinds of wiring problems faced with the RFID tag systems. Wireless motion detectors which use X10 technology in place of their own dedicated wiring, however, avoid wiring issues.

X10 wireless motion detectors are battery powered and transmit a radio signal to a receiving station every time they sense motion. The battery power and the radio signal communication allow them to be completely independent from dedicated wiring so that they can be attached to walls, ceilings, door frames or just about any surface in the home without concern over wiring issues. When motion is detected, the sensor sends a radio signal to a receiving station, a device that plugs into any electrical outlet within range. This receiving station sends a signal over the existing electrical wiring of the home. The signal is detected by a computer interface device that is also plugged into the same home wiring and, in turn, sends the detected signal to an attached computer for logging.

Motion detectors in general are noisy devices. Once they detect motion, they fire and then reset. After resetting, if further motion is detected, they will fire again as long as the motion occurs in their view field. This one characteristic may well be an advantage if general level of activity in a home is what is needed to provide peace of mind. Consider a person exercising in place. Motion detectors would continue to see motion even though the location has not changed. Other technologies, like RFID tags, would simply register that a person entered this one location.

Motion detectors do not have an absolutely stable detection field and their field of detection is hard to set up with any certainty. If there are multiple motion detectors whose fields overlap, both will fire, doubling the general activity level for that one activity. Careful and creative placement of motion detectors can partially resolve this problem. For example, by placing motion detectors above doorways with their detection field

pointed down toward the floor rather than aimed out into the room, movement from room to room can be detected.

As with other sensing technologies that do not provide a unique identity, the presence of multiple people in the home will increase the detected level of activity. An adult child with knowledge of his parent's schedule, however, might know that company was expected and could interpret this increase of activity as the presence of a visitor.

Finally the wireless sensor's need for batteries is an issue. If the installation is to be long term, the batteries will need to be replaced. Complicating this matter, battery replacement is not a simple matter of removing the old batteries and replacing them with new ones. Each sensor has an identification number that it transmits. When the batteries are removed, the code that the sensor uses is lost and must be reset. This makes them an good choice for field studies lasting less than a year but less desirable for long-term installations.

6.1.3 Strain Gage Based Sensors

A strain gage is a measuring device that changes resistance when flexed. Pulsors, a commercially packaged strain gage-based sensor system, is a third approach to sensing in the home. Attaching these devices to the underside of exposed floor joists allows the detection of the people walking on the floor above. For the Pulsor, this detection area is an oval of approximately 2 feet (one foot on each side of the joist) by 7 feet (along the length of the joist).

Pulsors require that the floor structure be exposed in a crawlspace underneath the area to be detected so that they can be attached. While this requirement restricts their use to a particular home construction type, unlike the RFID antennae the need to wire them back to the logging computer is ameliorated by their installation in the crawlspace out of sight. As with X10 wireless motion detectors, these devices do not provide any identification of the person whose movement is detected.

Strain gage-based sensors have the advantage over X10 motion detectors in their position certainty. With X10 motion detectors a sensor firing indicates movement somewhere in its sensing field. Depending on placement, aiming, walls and furniture, this sensing field may be as big as an entire room. With the Pulsor one knows with reasonable certainty that a person has stepped within the 2X7 foot oval detection area. If it registers that someone has stepped on the floor above, then one can be reasonably sure that a person is present. If two of these sensors that are not located adjacent to one anther fire at or near the same time then one can be reasonably sure that there is a second person moving about in the house.

A summary of the sensor selection criteria seen in the above discussion is shown in Table 14.

Table 14
Sensor Technology Suitability for Aging in Place Home Sensing

	RFID tag detection system	**X10 wireless detection system**	**Strain gage-based detection system**
Position certainty	High, Within feet	Medium Room level	High 2X7 foot oval
Personal encumberment	High RFID tags must be worn	Low, None	Low, None
Detection of multiple people	Yes, if multiple people wear RFID tags	Yes, if people are in different rooms	Yes, if people are one sensor (or more) apart
Person identified	Yes	No	No
System visibility	Without extensive retrofitting, yes	Only the wireless modules are visible	No, everything is beneath the floor
Ease of installation	Difficult. Requires wiring back to logging computer	Easy. Uses existing home power wiring	Difficult. Requires crawlspace wiring to logging computer
Home retrofit suitability	Invasive without retrofit, high impact otherwise.	Low invasive, low impact, highly suitable	Non-invasive; low impact, highly suitable for one home type
Ease of maintenance	Low maintenance once installed.	Battery replacement and required sensor reprogram.	Low maintenance once installed.
Believability	High, if the RFID tag is being worn.	Moderate detection field uncertain	High, an observed sensor firing is most likely a sensor firing.

6.3 DFP Physical Sensor Connection

As presented in Chapter 4, for the year-long field trial I selected the Pulsor as the sensor to be used to instrument Helen's home. In this section I present a greater level of detail about the process of making the actual physical connections that connect on one end, the sensors, to the other end, the computer.

Pulsors, the sensor chosen for the DFP year-long field trial, are glued, using an epoxy glue, to the bottom edges of the floor joists directly beneath the section of the floor of interest as shown in Figure 17 below. Attached in this way, they are capable of sensing when a person, moving about in the home above, steps within an oval of roughly two feet by seven feet in size. This sensing oval is seven feet along the joist (three and a half feet on both sides of the pulsor) and two feet across (one foot in before and one foot after the joist.

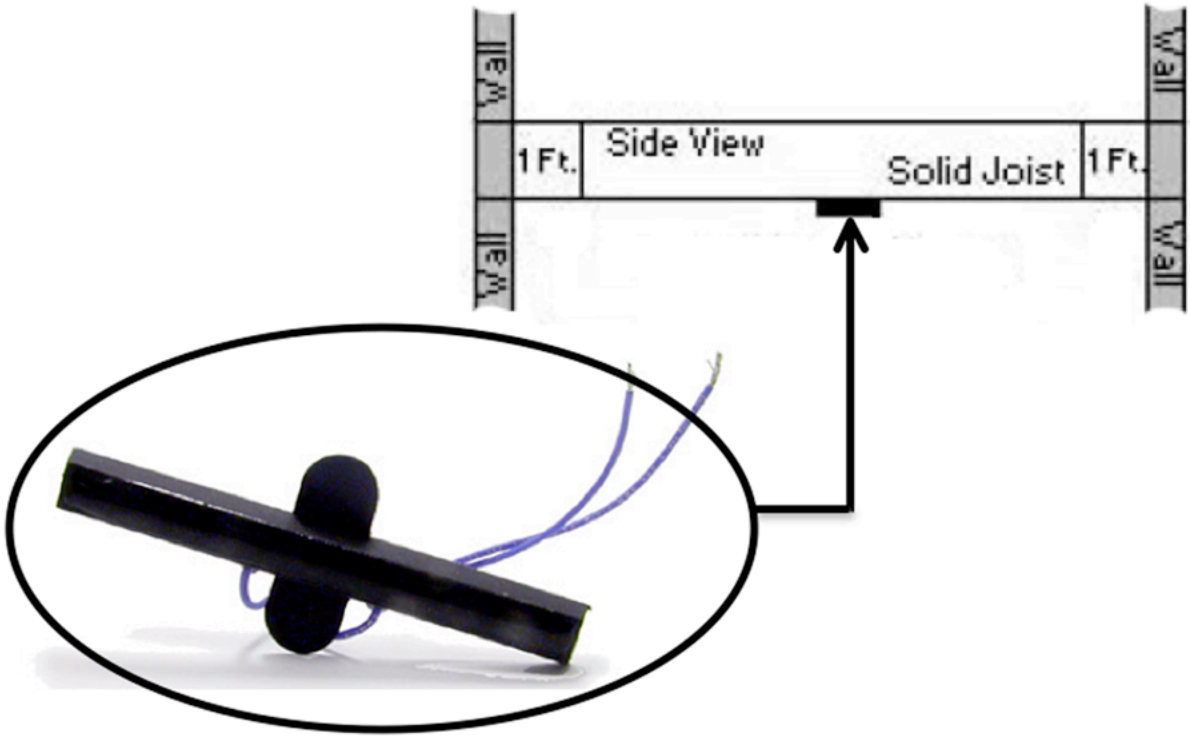


Figure 17
Pulsor Positioned Under Floor Joist

The two wires from each of the glued-in-place pulsors are connected by telephone wire to a pulsor controller that is located in a central location in the home that is designated for the sensing equipment. This physical connection is shown in Figure 18 shown below. Each of the controllers I used could support four pulsors. These pulsor controllers

converted the resistance change registered by the pulsor into an output signal that is the equivalent of a relay switch closure.

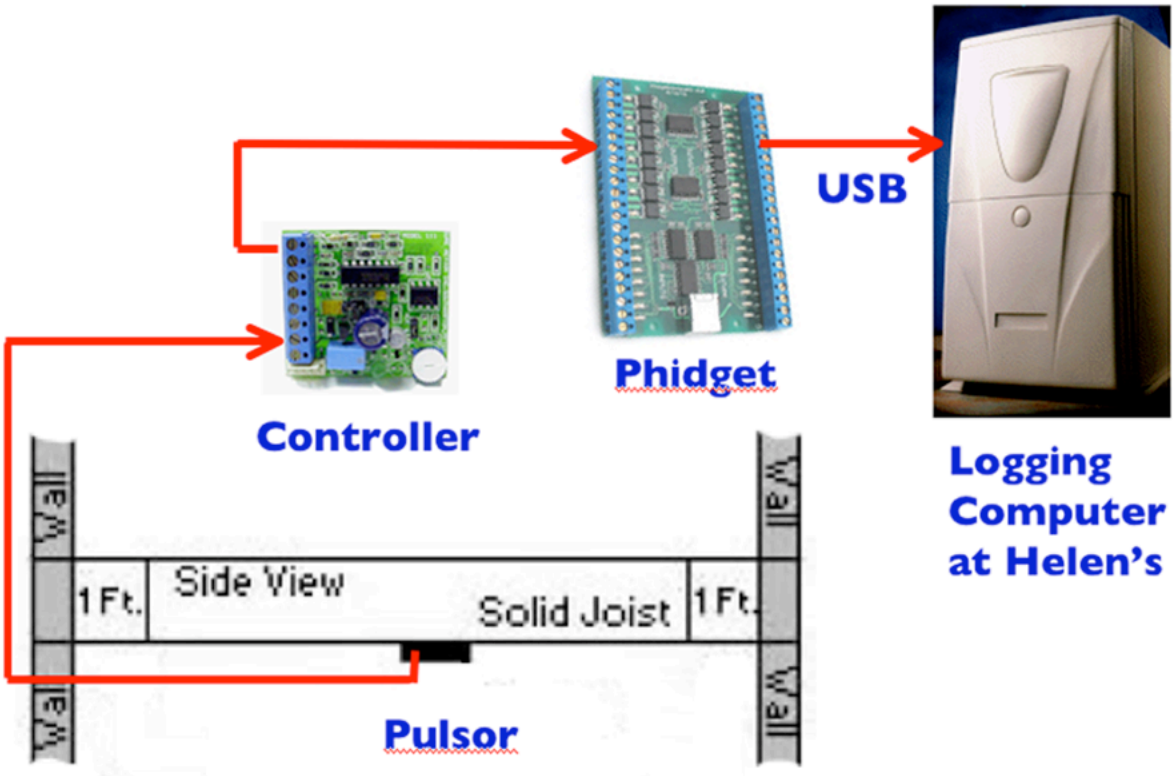


Figure 18
Pulsor Electrical Connection

The pulsor controller output is connected to an input port on a phidget board. The phidget board I use has the capability of supporting 16 inputs and 16 outputs, though in this experiment, the outputs were left unused. This phidget board takes the relay closure signals coming in from the pulsor controller and converts them so that they are transported to the computer (running phidget software) over a single USB bus. Once in the computer, a Java program collects the incoming sensor firing signals, timestamps and logs them.

CHAPTER 7

CONCLUSIONS AND FUTURE WORK

7.1 Conclusions

7.1.1 Contribution

The first contribution of this work is the identification of "peace of mind" as an issue that threatens "aging in place." This research was begun by investigating issues of aging. Motivated by elder adult's stated desire to remain in the familiar surroundings of the family home, the desire to "Age in Place," coupled with the profound sense of loss associated with a move to institutional living, I began an investigation into what causes aging in place to fail. While there are many reasons that include illness and injury, I identified peace of mind as an issue for the adult child. Since my investigation also revealed the adult child as the person who frequently drives the decision for an elder parent to leave the family home for the relative safety of institutional living where "at least someone will check in on them from time to time," a lack of peace of mind can cause the consideration of such a move even before there is a clearly identified reason other than concern that something might happen.

A second contribution of this work is the description of a technological intervention design concept that addresses the above identified threat to aging in place. With the lack of peace of mind identified as a threat to aging in place the question became "Can a technological intervention mitigate this peace of mind deficit?" To address this question I visualized a design concept on which the Digital Family Portrait would eventually be built. This design concept can be described as social communication technology that uses

sensing placed in the home of the elder parent to present a home appropriate representation of the well being of that parent to the adult child in the adult child's home.

A third contribution of this work is an iterative design exploration of the design concept outlined above. Having described a technological intervention design concept that addresses the threat presented by a deficit of peace of mind, I performed a detailed exploration of that design concept by building and iterating on instances of the Digital Family Portrait. Using mixed research methods this exploration led the design through iterations that arrived at a Digital Family Portrait deemed worthy of a year long field trial. Encouraging results from this field trial include that the representation and interpretation of activity mirrored actual activity in the home for both the elder parent and her adult child; that the design seemed acceptable for the elder parent to the extent of making her feel "less lonely;" that the adult child was able to interpret and use the data provided by the DFP and that he was able to couch the use of this data in a manner that was socially acceptable to his mother; and that the parent-child pair continued to use the DFP system long after the conclusion of the field trial and the cessation of monetary support provided to pay the monthly service costs of the installed networking.

A fourth contribution of this work is through the work's impact. One way that groundbreaking or innovative research demonstrates a contribution to the larger scientific community is through its impact on the world at large. This impact can manifest itself as media coverage in both the popular and scientific arenas. This media coverage is one measure of the research's ability to spark the imagination of others, causing them to think

in new and different ways about old problems. Though this media coverage is, in itself, not a necessarily a contribution, it may be seen as one early predictor of its eventual contribution generating effect.

As an innovative approach to one of the problems associated with an aging in place failure, a lack of peace of mind, the Digital Family Portrait has sparked the imagination of both the popular and scientific media. A partial listing of its media impact is given in Tables 1, 2 and 3 in Chapter 1. This media's ability to spark the imagination and bring about further scientific contributions is evidenced both by the large number of subsequent research papers that directly reference the Digital Family Portrait but also buy the increasing number of research projects that use the data set generate by the Digital Family Portrait's field trial dataset.

A final contribution of this work is the data set generated by the field trial. Captured in-situ this data set captures the movements and represents the actual daily activity of an elder as she lives out her normal life, alone, in her own home. Unusual and not previously available from other sources, this dataset has already attracted the interest of researchers using this kind of real-life data as a test bed for their work. Two of these research groups have written papers on their research that uses the data set as a test bed. Allison Woodruff and Ryan Aipperspach at Intel/Berkely [ACC0X] have used this dataset to conduct their research into predicting future behavior based on past behavior. Irfan Essa and Raffay Hamid treated the data set as an event stream to conduct research concerning the unsupervised discovery and characterization of activities [HMJ+05].

7.1.2 Design Decisions

This research was, in essence, a multi-year design experiment starting with the design goal of reestablishing peace of mind for the adult child of an older parent living alone, including many rounds of informal iterative design, incorporating the results from laboratory and field experiments and finally assessing the success of the design with a long-term field trial. In these concluding remarks, I attempt to summarize the most critical design decisions that I made throughout this research.

7.1.2.1 Choosing a portrait and augmenting its frame

The home is a special place. It acts as a stage on which we live out our lives, different from the world of work in that the environment of the home is free from many of the outside influences present in the work environment. We are free to shape it in any way we feel appropriate. For this reason any design that is expected to achieve a level of success in this environment must meet a different set of selection criteria than traditional work-oriented designs.

To succeed, a design must be emotionally appropriate as well as aesthetically pleasing. Lacking experience outside my own personal preferences for the home I decided to investigate objects already found in the home as possible mediums for information display. Of the choices that came to mind, a picture in a frame had many different advantages that made it stand out from the rest. First, it is a form that is frequently a representation of a person who is not currently present. It is commonly placed in areas of

the home that allow it to be casually viewed, becoming part of the background of things in a room until it is intentionally engaged. It has a frame that could easily be co-opted as real estate for the introduction of display data. Frames are frequently large in proportion to the image they surround increasing the available display real estate. They are also frequently decorative, allowing for the incorporation of display data, especially data couched in emotionally approachable forms such as graphic designs or iconic representations, without unduly standing out as different than other pictures in the home environment. Finally, a picture in a frame is rarely found by itself but rather it is frequently seen as one of a collection of pictures in frames. Assuming that there might be multiple people or multiple types of data to be displayed, this natural tendency to group them allows many different types of data to be inconspicuously displayed.

7.1.2.2 Identifying categories

Interviews with adult children and their aging parents, some living in institutional care settings and some living independently, led us to formulate general categories of information about daily life that are often shared between family members. These categories serve as a guide to what kinds of information support peace of mind.

- **Health:** In general terms how they are feeling that day. Did they sleep well? Eat regularly? Get enough exercise?
- **Environment:** The "health" of the environment. Has the weather been pleasant? Is something in the house broken?
- **Relationships:** Interaction with other people is important to one's emotional

well-being. This category includes a range of social interactions, whether in person, on the phone, or through written correspondence.

- **Activity:** The general level of physical activity can be a good indicator of the caliber of a person's day in both extremes. A low level of activity may indicate declining health, while a high level of activity may indicate the onset of incessant wandering behavior.
- **Events:** The occurrence of special events is an indication of the richness and variety in a person's life. This category includes activities, both planned and unplanned, as well as special outings.

Given that a picture frame has four sides, for the initial field trial it seemed reasonable to select four categories from these five and to display those four one to a side. Clearly these categories are not mutually exclusive. For example, a planned hiking trip with friends is a combination of three categories: activity, relationships and events. And a subsequent twisted ankle would show up under health and activity. The goal was not to create orthogonal categories, but rather to outline the kinds of things people talk about when they check in with each other. For the initial Wizard of oz simulation (Woz) field trial I selected health, relationships, activity and events, leaving environment for a later time.

7.1.2.3 Identifying salient periods of time

In the formative interviews at the beginning of this research, an implicit question was not only “what” did adult children need to know but also under what period of time. Early on it became clear that simply representing present time, such as one single day, was

insufficient as understanding trends that occur over time are important as well as supporting interpretation by allowing the comparison of one day to another. Informally it seemed that a week was too short a time period to assess well being over time. In my first design, I attempted to summarize 11 days of data for each of the four selected categories. In the final design, I opted for 28 days of a single category as it came close to a month and the visualization fit comfortably in the frame. That said, assessing whether "today was a normal day" was always an uppermost concern for adult children. Given this prominent concern, the data for the Digital Family Portrait in the long term field trial is summarized as a series of 28 individual days in the persistent display with the provision of an on-demand detailed display for each of those days in order to support further investigation of each 24 hour period.

7.1.2.4 Using icons

Having made the decision early on that the DFP should be designed to be emotionally engaging, the further choice was made to use icons, not some other form of graphic design, to represent the different characteristics on display. The intent of the Digital Family Portrait is to blend into the home environment as well as any other picture-in-a-frame might blend in. In order to accomplish this, I chose to use icons to represent the everyday life activity that is portrayed in the frame portion to provide a more qualitative, emotionally expressive display. While a qualitative display of this same information might seem to present the information in a more straight forward manner, it would give the display a more clinical, less personal appearance that would not fit into the home environment as well. The use of a more quantitative form of display, like the use of

numbers or graphs, would cause the Digital Family Portrait to stand out as different from the rest of items on display in a person's home and in doing so would attract attention to itself. The use of icons makes the frame appear more decorative and less clinical to someone outside the family, such as when hosting a visitor in the home, and in doing so would provide a level of respect for the privacy of the aging parent. Early Woz field trial result pointed out difficulties that rise from the use of icons for this purpose. Not only are icons difficult to design that can work across a variety of sizes, some of the naively designed icons were either misunderstood or misleading. It also seemed clear that icons could also carry a gender bias. To correct these problems, I conducted a series of laboratory experiments to determine which icons best fit which categories, to identify both those icons that have strong gender bias as well as those that have a neutral gender bias and to make certain that the different sizes that were eventually chosen were different enough in size to be discriminated.

7.1.2.4.1 *Selecting icons*

For the Woz field trial there were three different participants, a grandmother, a grandson and a granddaughter. Given that a picture in a frame is usually a remote representation of a person who is not currently present, it seemed reasonable that the DFP follow that model. This decision resulted in the selection of icons that were appropriate for a grandmother being used on the grandmother's DFP, the DFP that is viewed by the grandson and granddaughter. Conversely, the grandson and granddaughter's DFP, the DFP viewed by the grandmother received icons that were appropriate for grandchildren. Given the difficulties that rose during the Woz field trial from misunderstanding a

naively chosen icon's intended meaning, icon selection for the long term field trial was instead based on the results of a series of laboratory based experiments. At the time the code for the DFP long term field trial was being written, I did not know if my participants would be male or female, but I did know that I would be representing activity. Given this, an icon that scored high for representing activity and neutral for gender, the plain butterfly, was chosen.

7.1.2.5 Representing levels

Initially, during the design of the DFP for the Woz field study I chose to represent the level of a particular category as the density of the representational icon within a field. In choosing this approach, the density could continuously vary from 0% to 100%. After determining what level to represent, I evenly distributed the appropriate number of icons in the appropriate field. Since time for the Woz field trial is divided across three fields, each more narrow than the next, the icons also varied in size for each of the fields. The choice of a narrowing field with the reducing icon size as time passes was chosen as a visual metaphor.

7.1.2.5.1 *Representing levels and time*

The representation of category levels and time are intertwined in the Woz field trial so I will discuss them together. Initially, during the design of the DFP for the Woz field study I chose to represent the level of a particular category as the density of the representational icon within a field. In choosing this approach, the density could continuously vary from 0% to 100%. After determining what level to represent, I evenly distributed the

appropriate number of icons in the appropriate field. Since time for the Woz field trial is divided across three fields, each more narrow than the next, the icons also varied in size for each of the fields. The choice of a narrowing field with the reducing icon size to represent the passing of time derives from a metaphor of vision. The more distant, in this case in terms of time, the smaller the representative icon. The Woz field trial showed this to be a point of confusion because it was clear from the study that the participants were simply counting icons rather than judging density.

Given that for the Woz field trial the levels of categories were misjudged, and further, that the Woz DFP was also judged to be generally too complex, for the long term field trial of the DFP I decoupled level and time. Instead of bands of icons to represent time, I used a strict serial presentation of time. Each day was represented by a single icon with 28 days in total being represented on the persistent display. Level for the long term trial, rather than being shown as density, was represented as icon size. For the long term DFP field trial I decided to abandon the use of a continuous measure for density and instead go with four levels to be shown as four different icon sizes. This strategy required that the data be discretized into four different levels. These levels were chosen to accentuate the center of the range of the sensor firing counts which are shown as icon sizes 2 and 3. Unless a day was distinctly different from the normal, it would not stand out as distinctly different.

7.1.2.6 Persistent and Detail Screen Separation

In the Woz field trial I tried to pack a lot of information into a single display with the result being that the display was judged to complex and was also misread. To correct this, in the long term DFP field trial I took a different approach to the availability of detail. Rather than attempting to pack all the detail in one single display, I used a touch sensitive and simplified version of the persistent display with history being visualized serially. This touch sensitive screen supports participant interaction to access a transient detail display of a greater level of detail for a day selected from the 28 days displayed in the persistent display. To facilitate sense-making from the extra detail shown on the detail display, a means of navigation is provided to support the exploration of the data.

7.1.2.6.1 *Navigation*

With the inclusion of the detail display, I needed a mechanism to enable the viewer to move between the persistent display to the detail display and back again. Trying to create a simple metaphor for navigation the user need only touch the butterfly icon for the day in question to reach the detail display. A snapshot of the persistent display is located in the upper left corner of the detail display. To return to the persistent display the user needs to touch this snapshot. Additionally the detail display will timeout after a period of inactivity and the DFP will automatically return to the persistent display.

7.1.2.6.2 *Investigation of detailed data*

The detail display takes all the sensor firing data that is compressed into a single icon on the persistent display and spreads it, in 15 minute groupings, across a 24 hour day decompressing that single icon into a bar chart of 96 bars. Each of these 96 bars contain

all the sensor firings that occurred in that 15 minute time period. With this approach, the lack of activity during a 15 minute period of time shows clearly against neighboring bars containing sensor firings. This approach allows periods of inactivity lasting longer than 15 minutes to also stand out.

Given that long periods of time in which there is no activity might be problematic, or at least of interest to the adult child, a means of investigating this data in greater depth is provided. By moving a touch screen slider that is tied to the activity display shown beneath it, a floor plan is animated showing the sensor to sensor movement as it occurred. In the field trial the adult child used this slider to investigate large periods of time in which no activity occurred. Positioning the slider above the part of the activity chart that shows a lack of activity, the last sensor transition to occur was left illustrated on the floor plan. If the last sensors to fire were at an exit, then the lack of activity was due to no one being at home.

In addition it was planned that this slider arrangement could be used to investigate how activity occurred during the day. By moving the slider across areas of the activity chart that showed activity, the animated floor plan could be watched and something about the nature of the activity could be observed. During the field trial the adult child tried to investigate the data and determine his mother's dining behavior by looking for in-kitchen transitions. As implemented in the long term DFP field trial, the touch screen slider did not have sufficiently fine-grained control to support this kind of investigation.

7.1.3 Hindsight Perspective

Invariably, even with careful advance planning, things happen along the way that, if they had been known in advance of the research, would have been done differently during the research.

As it worked out, scheduling the main portion of the long term DFP field trial, that part of the field trial in which daily diaries were kept by the participants, presented a scheduling problem. The participants were real people with real lives and real problems and these problems conflicted with my research agenda. This caused the start of the diary portion of the research to be postponed until the year-end holidays which, as luck would have it, was a period of time in which no one would be at home. The end result was rather than starting and completing the main portion of the study before the holidays, it was instead postponed until the beginning of the next year. Had I known that in advance, I would have used the six or so months from when the sensors were first installed to when the diary studies began for design and testing of the interface, in particular, the detail display. This effort, perhaps, would have revealed the difficulty later encountered when trying to use the slider to investigate complex behavior like kitchen behavior.

Taking that realization to the next field trial, it would be advisable to design and install the sensor network and then start gathering data for an extended period of time, in advance of the main participant-intensive diary study. This approach would give a two fold advantage. First, it would give a good feel for the volume and the nature of the data coming from the sensors, a luxury we did not have before the design of the interface.

Second, it would give you a real data set on which to test the interface design, allowing for some evaluation and iteration on the design before it goes to the field. This is a major advantage since field studies are expensive both in dollars and in time. The more that can be tested and revised in advance of the participant-intensive portion, the further that field trial will carry the research.

A second insight revolves around the installation of sensors in someone's private residence. For my field trial, this was not a problem because all the sensors and the wiring were hidden in the crawlspace of the home. The living space was completely undisturbed. In the future work section that follows this paragraph there is a discussion of the use of X10 wireless motion detection as the sensing used in the home. This is entirely different than the sensing I used for the field trial because it is installed in the actual living space. These sensors are intended to be screwed into place and come with screws. The installation is not, however, the problem. When the study is complete and the sensors are removed there will be holes left in the wall. Using double-sided sticky tape does not solve this problem because it will damage the wall surface when it is removed.

Remembering that when doing research in private homes, the researcher is entering a protected environment that cannot be as zealously attacked as a laboratory space intended for that purpose. While it is my contention that by conducting this research in the actual environment of use provides insights that are unattainable in a laboratory, there is a price to be paid in time and in expense.

7.2 Future Work

7.2.1 Mining Sensor Data

Although this field trial concentrates on a six-week period, the activity data collected during the 12 months of monitoring represents a unique and valuable set of data worthy of further exploration. In the literature there is an absence of research data on a person's movement in his or her own house that is not biased by self-report or by third-party observation. I am in the process of several threads of analysis that would provide more sophisticated capabilities for future versions of the DFP.

7.2.2 Mondays are like Mondays

Above all, the crux of the question posed by adult children concerned about an elderly parent is "Was today a normal day?" Intuition tells me that certain days of the week will have a regular pattern. People tend to pick certain days to carry out particular tasks such as the laundry or yard work. Add to these routines the pattern of activity that is imposed from the outside such as work obligations, the pace of weekly events and even the schedule of trash collection, and life often assumes a semi-regular pace that changes slowly with more global rhythms such as seasons.

Although retired, Helen's schedule has patterns driven by her preferred routines and outside commitments. She has volunteer work on Mondays, goes to church on Wednesdays and Sundays, and does her yard work on Fridays. This regular pattern of activity provides the opportunity to characterize certain days of the week, and with this

characterization, provide a baseline such that the adult child can better determine whether or not a chosen day is “typical” or not.

One of the simplest ways to characterize a day is to ignore which sensors have fired and accumulate the number of sensor firings over a particular time period. Doing this calculation for the current day and displaying it against the background of previous similar days of the week provides a simple means of comparison. I took this approach in this field trial and it appears to reasonably characterize certain days making them distinct from other days. The best example is to look at Mondays which has a strong pattern (see Figure 19).

In Figure 18, one sees a single day, Monday, April 4, 2004 shown in green against the background of the 4 previous Mondays shown in gray. In Figure 19, one sees that same day in green but displayed against the background of the 4 previous consecutive days that include the previous Thursday, Friday, Saturday and Sunday. The pattern of green bars in Figure 19 clearly match the previous consecutive Mondays better than they match the previous consecutive days as seen in Figure 20.

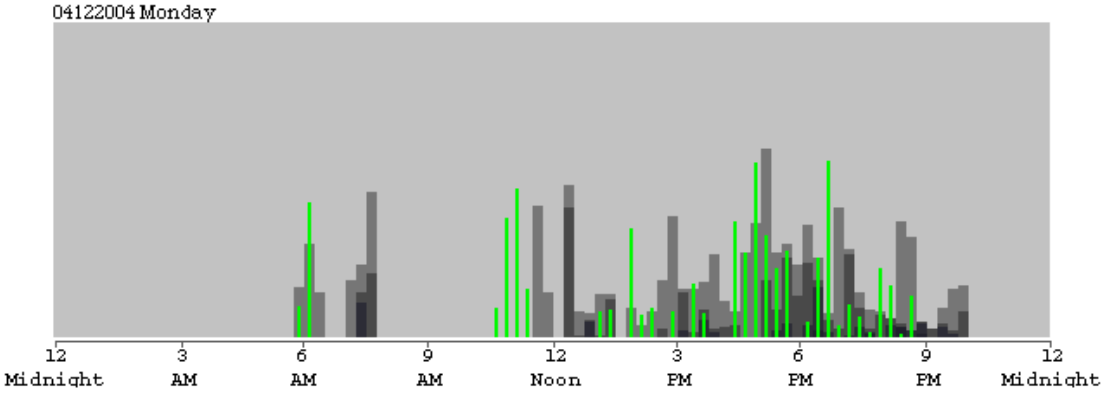


Figure 19
Monday Compared to the Previous Four Mondays

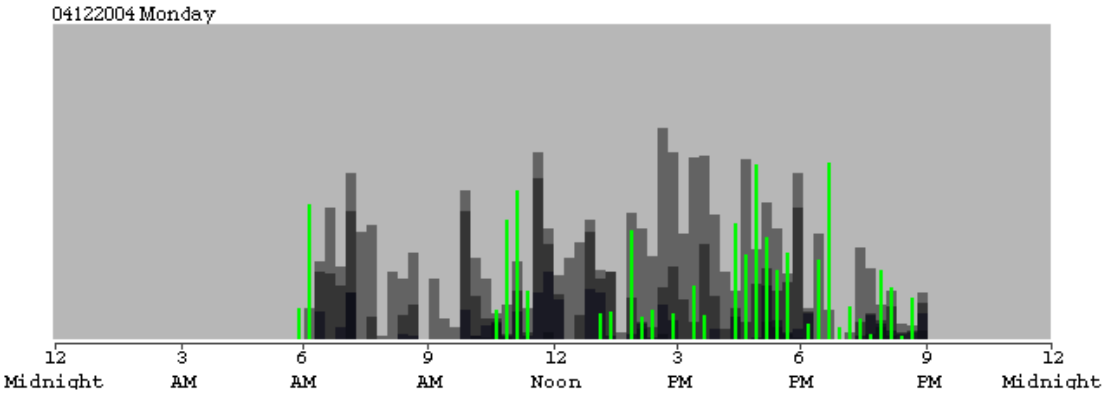


Figure 20
Monday Compared to the Previous Four Days

Going back to the data, I now have the opportunity to exhaustively examine similarities in common days (e.g. all Mondays) versus consecutive days (e.g. Thursday, Friday, Saturday and Sunday). Diary entries will help me determine days that were truly unusual in comparison to typical days.

7.2.3 Trends

What appears to be the second most common concern held by adult children about their aging parents is knowing if there are subtle declines in capabilities or subtle changes in behavior. Examples include sleeping less, sleeping more, eating less, general reductions in level of activity and a reduction in the ability to climb stairs.

The data available from the DFP sensors includes the potential for modeling the physical space (e.g. these three sensors are part of the kitchen), however the data is unlabeled in that there is no training data for what certain routines "look like" in the data. The future challenge is to determine what types of routines can be gleaned from this data and then to identify gradual changes in those routines. Although I do not know of any progressive declines in Helen's abilities during this field trial, I do know that her behavior shifted gradually with the changes in the seasons. This data has been made available to other research groups as a general test data set for evaluating pattern detection algorithms.

7.2.4 Sensing Multiple People

One potential difficulty with the data occurs when there are multiple people present in the home. Since neither the pulsor based sensing nor the X10 wireless motion sensors discriminate between individuals in the home, this has the potential to double the sensor firings in the house and to undermine any inferences made from the data. Under the assumption that this kind of sensing is not installed until there is an elder living alone, the adult child's understanding of the aging parent's usual and customary behavior will help them to understand the data.

In addition to relying on the adult child's knowledge of the parent's behavior there may be some ways to computationally understand the presence of multiple people. One promising approach for data coming from a pulsor sensing infrastructure is an exploration of discontinuous sensor firings as an indication of multiple people in the home, possibly even discontinuous sensor firings that occur in the same room. Clearly, if there are sensor firings coming from different rooms, either the pulsor sensing infrastructure or the X10 based system could detect their presence since the only time that this would occur is if there are two people in the home.

7.2.5 Future Field Studies

A considerable amount of effort is needed to conduct a study as seemingly simple as this one, especially for the first time. Coordination with one extended family, but two homes, can be challenging. I was fortunate in that both Helen and Will were motivated to participate although the initial motivation came from Will. Installing a network of sensors in a home is still not routine. Even the pragmatics of negotiating third-party payment for broadband connections proved more tiresome than predicted.

With this experience, I now have at my disposal a more easily deployable version of the DFP using X10 wireless motion sensors. The system now includes software for entering a home floor plan, configuring and calibrating the X10 motion sensors, and establishing the connection with the portrait display in the other home. X10 motion sensors are not only easier to deploy (they have batteries and transmit to a controller station using radio signals) but they have the added advantage of allowing sensing in parts of a home that

were not available for sensing using the pulsor since the pulsor requires access to the bottom of the floor joist. The batteries will have to be changed every so often making them ideal for research studies similar in nature to the DFP field trial. If the installation runs for long enough to require a battery change in the sensors then there are complications. Replacing the batteries requires resetting the sensor number for each sensor, a non-trivial exercise. There are also differences in the nature of the data collected.

7.2.6 Comparing X10 Wireless Motion Detectors to Pulsors

The data collected using X10 wireless motion sensors will vary somewhat from the data collected using pulsors. The first difference is that pulsors will fire only once when stepped on, unless the person stops at that position and waits until the pulsor controller resets in which case it will fire again when the person leaves the area. So, with the pulsor, there can be two firings in one position under these special circumstances. Compare this to the way that X10 wireless sensors would behave under the same circumstances. With the X10 wireless sensors, a person can move to one position and stop in that position. If the person were to stand in place but move his body around, as would be the case if they were standing in front of the sink washing dishes, the X10 wireless motion sensors could easily register quite a number of sensor firings while the pulsor would register only one.

A second difference involves the sequence of firings. Given that there is one person in a room and there are a number of pulsors in that room, only one will fire at a time allowing the person's movement to be reliably tracked as they move from position to position.

Multiple X10 motion sensors in that same room may fire, determined by the position of the sensor, the arrangement of furniture in the room and the direction in which the sensor is aimed. Also, in the case of the X10 wireless sensor their detection fields can cross and cause double coverage of one area in a room, something that is not possible with the pulsor. While something can be gathered about a person's movement in that room based on X10 sensor firings, it cannot be counted on to reliably track a person's actual movement in a room.

A third difference is really another way of looking at the disadvantage discussed in the two paragraphs above. Motion at a particular place may well be more interesting than being able to reliably track a person through a house. Continued motion in one position in front of the sink may be telling one something that can be used to reliably infer meal-making behavior. With the pulsor arrangement, all that would be known is when the person arrived and left that location. Pulsors would not be able to distinguish between activity at one location and simply standing still at that location.

In addition to the above stated differences in the nature of the data collected, it seems clear that a number of X10 wireless motion sensors will generate a considerably greater number of sensor firings than would an equal number of pulsor sensors.

7.2.7 Digital Family Portrait as an Early Intervention Vector

Part of my future work involves partnering with other research groups to develop additional functionality that can ride on the back of the DFP, This is particularly

interesting when one consider that DFP has been shown to be useful in the lives of aging parents and their adult children well before any real aging-related issues are present in their lives. Looked at in this way the DFP can be viewed as an early intervention technological platform onto which additional functionality can be added as needed. In this way the basic technological intervention can occur long before there is any real detectable decline. This in effect lowers the intervention threshold for functionality once that functionality is determined to be actually needed.

7.2.8 Combining Medical and Activity Monitoring

One such effort is combining my activity monitoring and wearable medical monitoring for older adults who have more severe medical concerns. I am working with Siemens to investigate the combination of wearable blood pressure and glucose level monitors with activity monitoring for older adults with Type 2 diabetes. Different visualizations are needed for the clinical physician reviewing data periodically, for the older adult monitoring his or her own data, and, for now, the traditional DFP interface augmented with medical data for family members. I am interested in how these two types of data aid families in noticing deviations in behavior and aid clinicians in understanding the larger context surrounding medical data.

7.2.9 Activity Monitoring for Proactive Interaction

We have also been approached by another research group interested in using the DFP technology as a proactive interface for older adults grappling with debilitating depression. In addition to providing awareness information to concerned family members, the system

would detect extended periods of low activity and attempt to encourage more healthy behavior. A personalized visualization would also help the older adults assess their good and bad periods, perhaps helping them draw the correlation between more activity and feeling better. Of course this scenario introduces more challenges for adoption and acceptability of the system by older adults.

Both avenues of future field trials point to the potential utility of the older adult reflecting on information about themselves as they work toward maintaining or improving their quality of life and independence.

APPENDIX A

Wesley Woods Site Visit #1 field notes

Trip to Wesley Woods
4/28/99
8:30 AM

[name expunged]
Chaplain Supervisor
Black woman
A beautiful facility didn't change the concern about moving.

[name expunged]
Pastoral Services Fellow
Emory Health Care
The Robert W. Woodruff Health Sciences Center
Wesley Woods
404 282 7113
[hyperlink]
She uses her email!
She is writing a book about her personal experiences with Alzheimer's disease.
Has collected stories and translated them into poems.
Mentioned Ericson's Ladder
Former GaTech student.
Dignity is the key.
Don't treat them like they are "not there"
I mentioned parallels to the way children should be treated.
She stated that near the end of life one tries to reconcile what was actually done with what one had planned. A way of assessing the worth of one's life.
I read her stories:
String too short to use
Hey Preach! Do you know my name? Do you know me?
To Be Free.
The tough brilliant outspoken agnostic.
$1500 to 2000 per month for assisted living

[name expunged] talked to her while I talked to [name expunged]
[name expunged]
Alzheimer's Association
Family & Community Services Coordinator
[phone number]

HYPERLINK [hyperlink]

I spoke to [name expunged]while [name expunged]talked to Kim[name expunged]
[name expunged]Alzheimer's Association
Director of Chapter Services
[phone number]
[hyperlink]
She knows Newt and he has an interest in Alzheimer's.
I mentioned that Newt talked to us concerning this.

[name expunged]
Director
Activity Therapy Department
Budd Terrace
[Phone number]

[name expunged]
Formerly of
Alzheimer's: Guided Management
[phone number]
Now
The Program Director
Alzheimer's
@ the "Jetson Towers"
[phone number]

[hyperlink]

[name expunged]
[phone number]
Chaplain for "Jetson Towers"
Has an ego.
Likes to talk.

Budd Terrace is a Nursing Home that is really several nursing homes in one.
They are divided between floors of a 7 floor facility.

The "Jetson Towers"
Residence hall
Not an assisted living facility
BUT
They are dealing with how to manage Alzheimer's to delay their resident's move to assisted living facility.

The Chaplain Meeting at 8:30.
[name expunged] Head Chaplain dude, not present.
[name expunged] Chaplain? In attendance
[name expunged] new chaplain Interested in physical arrangements

Aging in Place is a Gerentological expression

The Elder is a film 5 minutes that they show all new employees

Moves to assisted living are rarely voluntary.

Some feel liberated by the move to assisted living
Generally feelings of
Abandonment
Fear
Guilt
Sadness

Staying at home issues.
How can I care for a pet?
Medication is difficult.

Comfort level is important when one moves to assisted living.
Do I have a piano?
Falling is always a problem.
Can't get out of the tub.

Not chain link fences, they afford climbing.
Wooden fence with tall shrubs in front better.
Fear is a problem.
The senses become more acute with the onset of Alzheimer's
Depth perception starts failing early.
Balance is lost in the middle.
The appearance of choice is important.
Just having an area to open a door and walk out onto is important, but it must feel safe.
An Alzheimer's patient will just as soon go out an open window as a door.

Designing for Alzheimer's Disease
Elizabeth C. Brawley
Wiley and Sons
Isbn 0-471-13920-3
1997

APPENDIX B

Wesley Woods Site Visit #2 field notes

Trip to Wesley Woods
4/30/99
11:00 AM

Meeting with [name expunged]
Roman catholic intern
In his second year at Wesley
Wesley Towers (Towers) in competition with Clairmont Oaks

[name expunged] administrator [phone number]
[name expunged] assistant administrator
[name expunged] Resource Coordinator -handles transition issues

Towers
When it opened, median age 65
Now median age is 85, the range is 72-106
As long as they function on high level cognitively they try to do everything they can to keep them in the Towers even if they function fairly low level physically.
Some of the residents dislike the low-function physical people
He speculates it reminds them of their frailty
Only 5% of the nations population suffers from Alz
Residents have hearing and seeing problems
Some need physical assistance
Incontinence is also a problem
Towers residents have events… concerts, field trips, religious services, exercise class
220-240 residents
Also husband/wives
Communal dining for all, one meal a day, choice of lunch or dinner, most choose lunch
6 month waiting to get in
11 floors
second floor is for lower functioning residents… a kind of waiting area for Budd terrace
Procession thru Wesley: Towers(independent), Budd Terrace(various nursing home facilities), A.G. Rhodes (heavy nursing home facility)
Towers: some maid service avail
There is an indicator that each resident must change each morning to show that they have gotten up.
Predominant feeling on entry to Towers is a feeling of loss.
Children are usually heavily involved in the decision to move to Towers in perhaps 50-70% of the entrances.

Steps of emotional adjustment Acknowledge loss, then help t hem come to terms with the loss
ADL's are informally assessed but it may proceed to a more formal assessment if indicators are there
Dignity and independence are the elderly parent's issues
Coping with their own mortality is the issue with the adult child
Residents should be treated with respect, not talked down to.
Technology needs to be simple and self explanatory
Symbols and pictures are important
Use large print
Perception or reality of dignity
Dignity and loss are tied
Very few pets in the towers
Kids and pets are critical to the elderly
The elderly love both
Scott reaffirmed my feelings about homogenous age grouping
Psychological peace of mind for the adult child… Mom and Dad are taken care of.

Visit to the towers
Dining area comfortable with fireplace… Is it used?
Public areas have nice appointments
There is a garden area for residents who want to garden
Plants in the public areas are attended by the residents
Rooms seem very small… more like dormitory
Central area in each "pod" seems uncomfortable
Second floor for residents with mobility problems, dining area provided for second floor residents, kind of a staging area…

APPENDIX C

Initial Field Trial Grandparent's initial interview questions

Where you raised in Atlanta?
How long have you lived here?

Neighborhood?
In house?

Tell me about
your children.
your grandchildren.

What do you do for fun?
Movies? TV? Dancing? Theatre?
Camping? Fishing? Travel? Read?

Where do you go on vacation?

How is your health generally?

Do you have a group of friends that you meet with regularly?
(Bowling, Bridge, Garden Club?)

Do you have relatives that live in Atlanta?
Are your parents alive? Where do they live? How is their health?

Do you do volunteer work?

Do you do any sports?
(Tennis, walking, bicycling?)

Tell me about
any internet experience you have had.
your computer usage.

How frequently
do you visit with your grandchildren?
in person or on the phone?

Have you ever lived with your grandparents?

APPENDIX D

Initial Field Trial Grandparent's DFP use instructions

This project, called FamilyPortrait, investigates an approach that would allow people who are separated by distance to keep track of one another's daily activities without demanding their direct attention. The idea is to provide the kind of presence awareness that comes naturally when the parties live in the same neighborhood. For example, if your Grandmother lived next door you could look out the window in the morning and see that she has picked up the morning paper. From that you know that the night has gone well for her.

Your grandchild's daily activity will be displayed in the form of a framed picture.
The frame of this picture will carry information about the child's daily activities.
This information found in the frame will not be presented in a direct manner, that is to say, there will not be words describing the day.
Rather than words there will be pictures.
The images used to represent the aspects of your grandchild's life are adapted from the work of artist Keith Haring.

The top of the frame is a display of entertainment

Right is health and is represented by

Left is activity and is represented by a

Bottom is relationships and is represented by

APPENDIX E

Initial Field Trial Grandchild's DFP use instructions

The images used to represent the aspects of your grandparent's life are adapted from the works of American artists Georgia O'Keeffe and Mary Cassat and the French artist Edgar Degas.

The top of the frame is a display of entertainment and is represented by images ballerina French impressionist painter Edgar Degas.

Right is health and is represented by a flower by the American artist Georgia O'Keeffe.

Left is activity and is represented by a goldfish.

Bottom is relationships and is represented by an image of mother and child borrowed from the American impressionistic painter Mary Cassat

APPENDIX F

Initial Field Trial Summarized Pre-Experimental Interviews

General daily routine interview

[constance]
Works regular job
Walks 2 miles three times a week
Watches TV
Enjoys plays, went to Dahlonega's Sound of Music
Attends church regularly

[caitlin]
Mom drives her to school
Got Internet access again for the purposes of this study.
Plays soccer
Has a black lab named Sugar
Next door neighbor has 3 cats
Library every other day and the librarian reads them books
Has younger sister named Taylor who is 6
Likes Beverly Cleary books
Reads every night
Rides bikes
Rollerblades
Has the same teacher every day except gym and social studies
Likes to mix up stuff in the kitchen with her mom
Swings and plays kickball during recess
20 kids in a classroom
k-2 in one school, 3 and up in another next door

[thomas]
Goes to school
Likes Gym
Recess, a cool swing & played batman, played tag
Like
He goes to the yahooligan website
Plays football MWF
After football he comes home, takes bath, goes to bed.
Likes Pokeman TV program
Likes Sports Illustrated for Kids… Cool
Likes Legomania magazine
Doesn't usually read before bed
Attends church on Sunday
He has Internet at home but is not allowed to use it freely

8/28

[constance]

[caitlin]
Does not have Internet access but will have it by Monday.

[thomas]

8/29
[constance]
Went to church
Went to tour a 1.9 million dollar home on the oconee river, a two hour trip
Rode in golf carts
Ate out at the Varsity
[caitlin]

[thomas]

8/30
[constance]

[caitlin]
Likes basketball and played with her dad
EAHR: 5 5 5 5
[thomas]
Missed gym because of a test called Horizons
Recess, a cool swing & played batman, played tag
Football practice

8/31
[constance]

[caitlin]
She asked about whether the dancer meant anything in particular.
Read a book about animals today in her spare time
Got a new purple bike
Rode the bike with her friends in the driveway
Stayed outside until dark
EAHR:5 8 6 9

[thomas]

9/1
[constance]

[caitlin]
At recess formed teams to see who could swing the highest, her team won.
Library: Was read The lady with the alligator purse.
Taco salad, cookie, skim milk for lunch
She complained about the loud 4th graders… it seems her room is close to the lunchroom
Going hunting with her father, his friend and his frien's daughter tonight!
EAHR: 5869

[thomas]
Football practice
9/2
[constance]

[caitlin]
Hunting last night
Out till dark in a boat
Didn't ride bus, dad took her to school because he is the one that kept her out late

Did computer stuff at school today… reading stuff…
AppleHouse game and Muffin Airplane game
Went to music but watched half of the movie Mulan instead
Played folder game
Worked on her desert habitat
Soccer practice today
Packing for labor day trip
Finished homework before soccer
Her daddy's friend has 10 dogs!
She joined MooseCrossing and her name is Sugar…
Will probably read a little after soccer
EAHR: 7656

[thomas]

9/3
[constance]

[caitlin]

[thomas]
Football practice
9/4
[constance]

[caitlin]
Friday is fun Friday
Get to watch movies
Finished Mulan
Watched the Fox and Hound in Art class after lunch… on a scale of 1-10 it was an 8 or a 9
Waiting for moms to pickup, they play the Quiet game

[thomas]

APPENDIX G

Grandparent's Post Experiment Interview

(Interviewer) What can you tell me about the experience
…did it make sense?
*Yes it did make sense… I guess the part I enjoyed was to compare (the two pictures of the grandchildren) to see how busy the two were… [thomas] against [caitlin]… and the different activities.

(Interviewer) You looked at the pictures and you could tell that [thomas] is a little more busy than [caitlin]?
*At times I could tell… it was different times… different ones would be busier the other one depending what was going on…

(Interviewer) Did you know that [caitlin] went hunting with her father?
*No… I haven't talked to her I talked to her mom every day but usually they ([caitlin]) is not home when I call

(Interviewer) Yes, they went out hunting I think Thursday night and that's when things got really busy…
*I noticed she all of a sudden got… (really busy)
(Discussion of where [caitlin] went over labor day)
(Discussion about the differences in the raising of [caitlin] and [thomas]… the two subjects)
(The gist of this is that [caitlin] doesn't watch much TV as [thomas] and is kept busy by her mom with other things)
[thomas] is busy with football but [caitlin] has so many outside activities… (scrapbook craft discussion)
Discussion: and comparison between the two kids.
Discussion: Tim([thomas]'s father) was more concerned about having [thomas] up on the web
Discussion: There were discussions between [constance](Grandmother) and Jackie([caitlin]'s mother) about having [caitlin]'s picture up on the web… Child pornography concerns…
Discussion: Tim and his career…
I told her (Jackie) that two weeks was too short a time for anyone to get her picture
[constance] agreed to allow the use of her picture
Discussion: FCE brown bag presentation
is anyone else working on this project?

(Interviewer) No, just me (and of course my esteemed Professor!!!)

(Interviewer) We talked about the icons and there were concerns about the icons at FCE…

(Interviewer) Now what was Tim's concern about the icons?
*The fish, he couldn't understand the fish by my… my acitvities… [caitlin]… she laughed… she and her Mom thought I went fishing… well they really knew that I didn't go fishing but [caitlin] said "Did momma Nell go fishing?" But Tim couldn't associate the fish… but… well… I associate it with activities… well I'm busy… not that I did anything much this two weeks outstanding but I was just busy and I said I associate it with that…

(Interviewer) Do you think fish… fish are a good picture to use… I mean do you relate that with busy things?
*I do… I mean I did because fish are just swimming all the time in water and I just related it to that

(Interviewer) Well that's what we are trying to pick up on so I'm glad… its interesting that you would…
*Well I did but Tim couldn't quite understand the fish…
And then… um… the llittle ballerinas I took it… because I like plays and I've been to plays and that's why you picked that..

(The apparently spent a good deal of time trying to "figure out" what the pictures meant and why those pictures were chosen for them. The sense is that the icons chosen are taken very personally)

And the roses… I guess because I'm healthy and I just… roses you think of something pretty and healthy so that's why I associated it with that…
… now the bottom one… I don't know… I think it was little um… little dogs wasn't it (YIKES!!! Dogs???)

(Interviewer) actually it was a picture of a mother and child…
… oh… is that what it was…

(Interviewer) That's the one we worked on the longest to make it read but it just didn't read… well what about the ones that we used for [caitlin] and [thomas]?
*Ok… I thought that… um… the little people on the activities… I couldn't decide if they were exercising or if they were playing…um… an instrument… but I described it to Tim I said they are either going to start playing an instrument or they are fixin' to do some exercises or something like that… What was that?

(Interviewer) They were dancers… those pictures were all taken from an artist who is

called… um… Keith Haring
*Well I kinda associated it with musical instruments because they were standing like this (she demonstrates) and I felt like they might be fixin' to play an instrument of some kind… a violin or something.
… and then at the bottom… the little um… the little guy holding the um… dog (DOG???) is that what that was?

(Interviewer) It was a little baby…
*A little baby… oh… well I should have associated it together with relationship but I could tell they were holding… and I just associated the little child with the animal.
And then at the top it was uh… you'd think with me going here every day I'd…

(Interviewer) Well I work with them all the time and I have to stop and think about it sometimes…
*I know exactly what that was at the top… uh… oh, it was a little computer was what it was… Is that what it was?

(Interviewer) It was a little tv
*A little tv… is that what it was? Yeh and I thought that was neat for the uh entertainment because they all do enjoy that
And then their health it was uh… what was that uh… little dogs?

(Interviewer) Little babies…
*Yeh the little babies looked like little babies… you can't tell… I picked little animals out of it

(Interviewer) That's one of the problems… we had great pictures but…
… when you shrink them down that tiny you can't tell what some of them are…

(Interviewer) Did it bother you that you couldn't tell what they were?
*No because I associated it … I just took it and associated it in my mind as to what it was and so… no I didn't have a problem with that…

(Interviewer) Did you have any trouble deciding about how many… whether it was a lot or a few or…
*Well at the beginning I got confused… the first day was no problem because it was the first square… then the next day… I went to the middle square and Tim told me that I was supposed to stay in the first square…

(note: As it turns out they filled out the questionnaire with only one ranking per side, not three. They were ranking, say, activities, as a whole based on what they saw. I could have provided better instruction I guess…)

(it will be interesting to see how [caitlin] filled hers out)

(Interviewer) It doesn't matter so we'll…
*That was a little bit confusing but uh…
No problem… I found out that at the very end [caitlin] really got busy (Yes she did!) That's the time I gave her a 10 for activities and she got a 10 for relationships for that last one (So she really noticed the increases that I had put in there with [caitlin] going hunting with her father and then going to the lake for Labor Day!)
She got… well both of them got really busy… [thomas] never was quite… well for relationship I gave him a 10 there… they just got a few 10s there at the very end

(Interviewer) What was that (what day)? Oh yeh he went to his cousins for a birthday party and uh he spent the night and spent the next day there so he was really busy with a bunch of friends…
*So I could tell you know… during the holidays… so I assume that is why… now you can tell that they had extra activities on this very last day…

(Interviewer) Lets say for instance, God forbid, [caitlin] were to move to the west coast…
Wow! Please! God forbid not…laughs..

(Interviewer) Let's just say uh… what would you change about this or how would you arrange this… like if you had a computer at home and you could have this picture up and look at it and kinda get a feel for what she is doing maybe… you know… what would you change about this to make that work better for you?
*What would I change to make it work better (to herself) uh… well lets see uh…
This would be a neat way to describe to your uh… grandparents… if they went in there and put this on that would definitely be a neat… I wouldn't be concerned with you know… the um… I'd be looking at one day at a time…
But this would definitely be a neat way to um interrelate with a grandchild (thank you [constance]!)

(Interviewer) You think so?
*Yes because you can see… I mean she can go in and put in what she is doing and everything… and I can see that she is real active in what…

(Interviewer) So you'd like her to be able to go in and decorate this herself?
*Yes that would be… um… and I never even thought about it for something like that…

(Interviewer) We've thought about it that way and another way would be to have it…

(Interviewer) Suppose that by some magic all this stuff could automatically happen and [caitlin] wouldn't have to do anything would that… would you find that useful or would

it be more interesting and helpful to have her decorate it?
*I think it would be more interesting for her to decorate it (of course! Grandmas are like that) so she could put into it her feelings so that I could see them… I think that if it was automatic it wouldn't be as fun to see because um it might not relate quite as well as her putting it in herself…

(Interviewer) … one of the problems with that would be that she would have to do it every day so you don't know… there might be a way to do some kind of a mix so that some days she could float along…
*But a program like this would definitely be great for the parents, the grandparents or whoever or if the grandchildren moved away… this would be a great program to um

(Interviewer) You think so?
*Yes

(Interviewer) Does it bring anything to the relationship that a phonecall wouldn't bring?
*Well, the only thing it would bring is that the fact that the phonecall is so fast and you can go back and look at this many times…

(Interviewer) … so the consistency and presence… that it's here all the time…
right. Where with just a phone call you are not seeing her in person… well your'e not seeing her in person (with FamilyPortrait) but it is the next thing to in person (!!)

(Interviewer) So you felt like you were looking at [caitlin] and you felt like you were looking at [thomas]…
*Right… exactly
I have many pictures of my family from the early 1900s and I use photoshop to go in and enhance them and crop things… I made a birthday card for my father's 70th birthday… And it is amazing how close you get to somebody by thinking about them and just looking at the picture…
Oh yeh… oh it is… definitely… and my daughter was so good about when they (the grandkids) were growing up… every three months making pictures and sending them… And that picture there we had that picture made… [caitlin] was just a baby when we had that picture made… so I gave allthe kids one for Christmas that year and she (Jackie) put hers in the hall where every day as [caitlin] went by she could see that that was us… and Jackie would say "now that's momma nell and papa jack so she could recognize our face… so this (FamilyPortrait) would associate like that… you'd see it on a daily basis and you uh… and especially for a small child.
Yeh…
Sometimes it would be two months before we would get a chance to see each other even though it wasn;t that far… but when you're working and you can't go on a regular basis… so it was real good for that… a picture anytime is good…

(Discussion of video instead of static picture… I point out that there would be a lot more to deal with as far as equipment is concerned and she volunteers:) speaking of me in particular… for older people the more equipment the more aggrevating it is…

(Interviewer) We thought about allowing people to select their own pictures… coming in with a digital camera and take a bunch of pictures and allow the subjects to select…
*For the grandchildren it would improve it because you could pick out different pictrures for different activities (She wanted the icons to be more literal)

(General discussion…)
She talked with [caitlin] a few times and to [thomas] just once but [caitlin] and her mom had a ball with this. They couldn't wait till the next day to see what gma is up to…

APPENDIX H

Gender and Category Icon Questionnaire

Please tell us if you are either female_____ or male_____

For each of the icons below:
1) Rate them as female or male in character.
2) Categorize them as either related to health, activity or relationships.

For example: If you believe one of the icons to be strongly feminine and representative of someone's health you might circle the number 3 on the Female side and check the box in the health column.

	◄Female					Male►		health	activity	relationships
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐

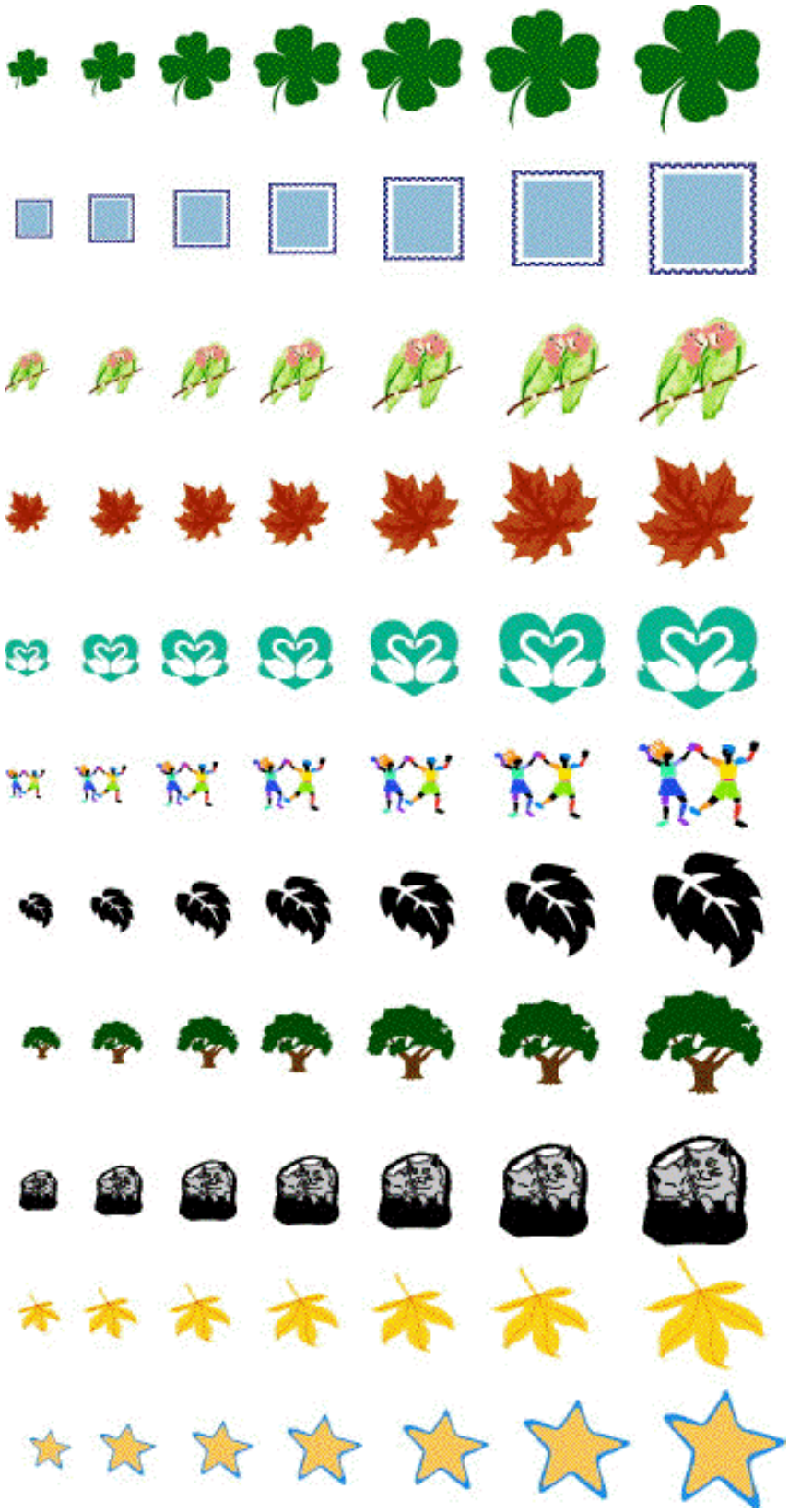
APPENDIX H (continued)

	Female					Male		health	activity	relationships
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐
	3	2	1	0	1	2	3	☐	☐	☐

Your COMMENTS are welcomed!

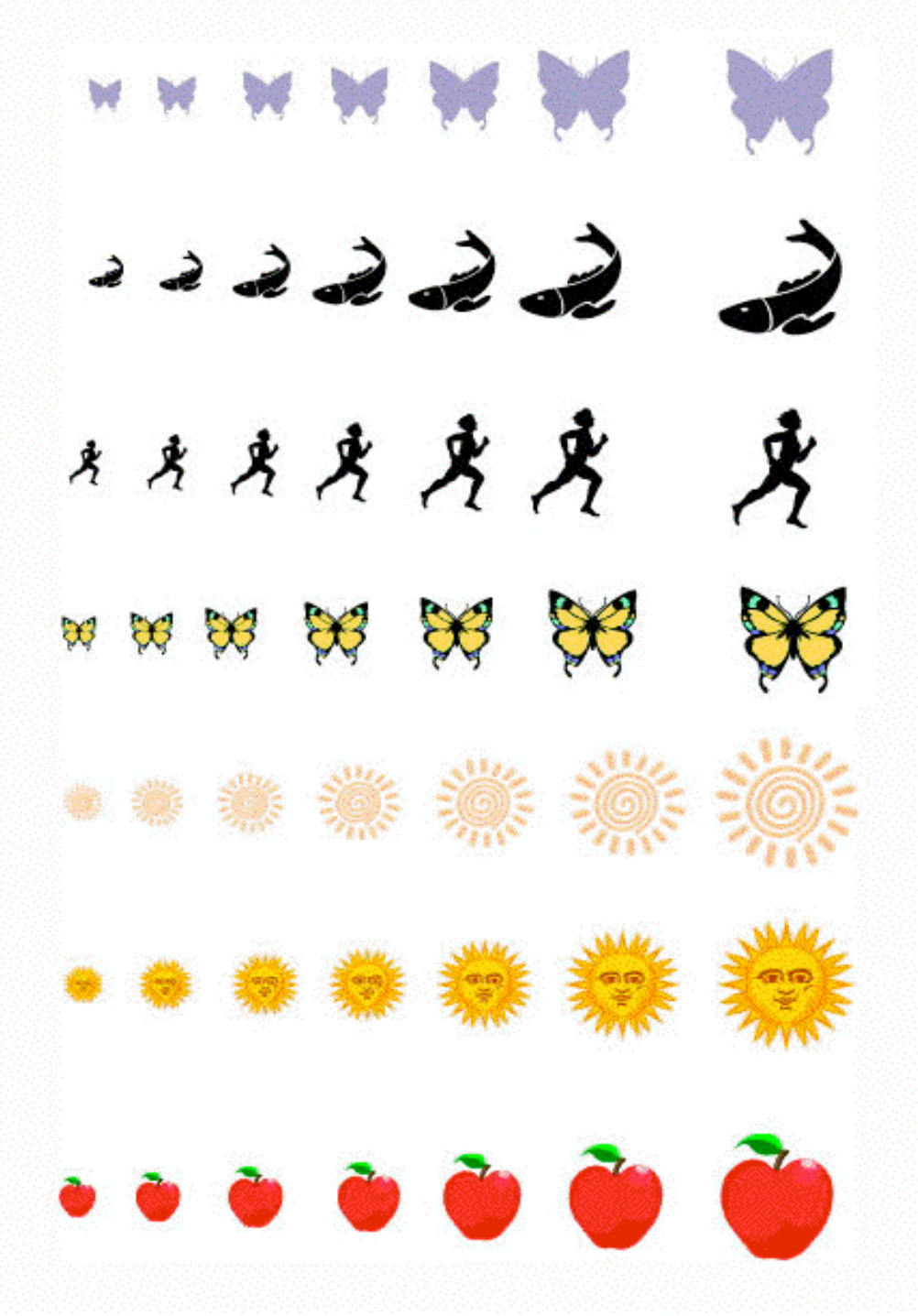
APPENDIX I

Icon Palette



APPENDIX I (continued)

Icon Palette



APPENDIX J

Icon Questionnaire Results: Meaning Classification

Icon	Number of subjects	Number of "No" Responses	Health %	Activity %	Relationships %
 icon1	15	2	47	27	13
 icon2	15	0	0	7	93
 icon3	12	3	25	75	0
 icon4	15	0	0	0	1
 icon5	15	0	9	56	42
 icon6	15	1	73	13	7
 icon7	15	3	4	4	0
 icon8	15	0	5	43	7
 icon9	15	0	87	7	7

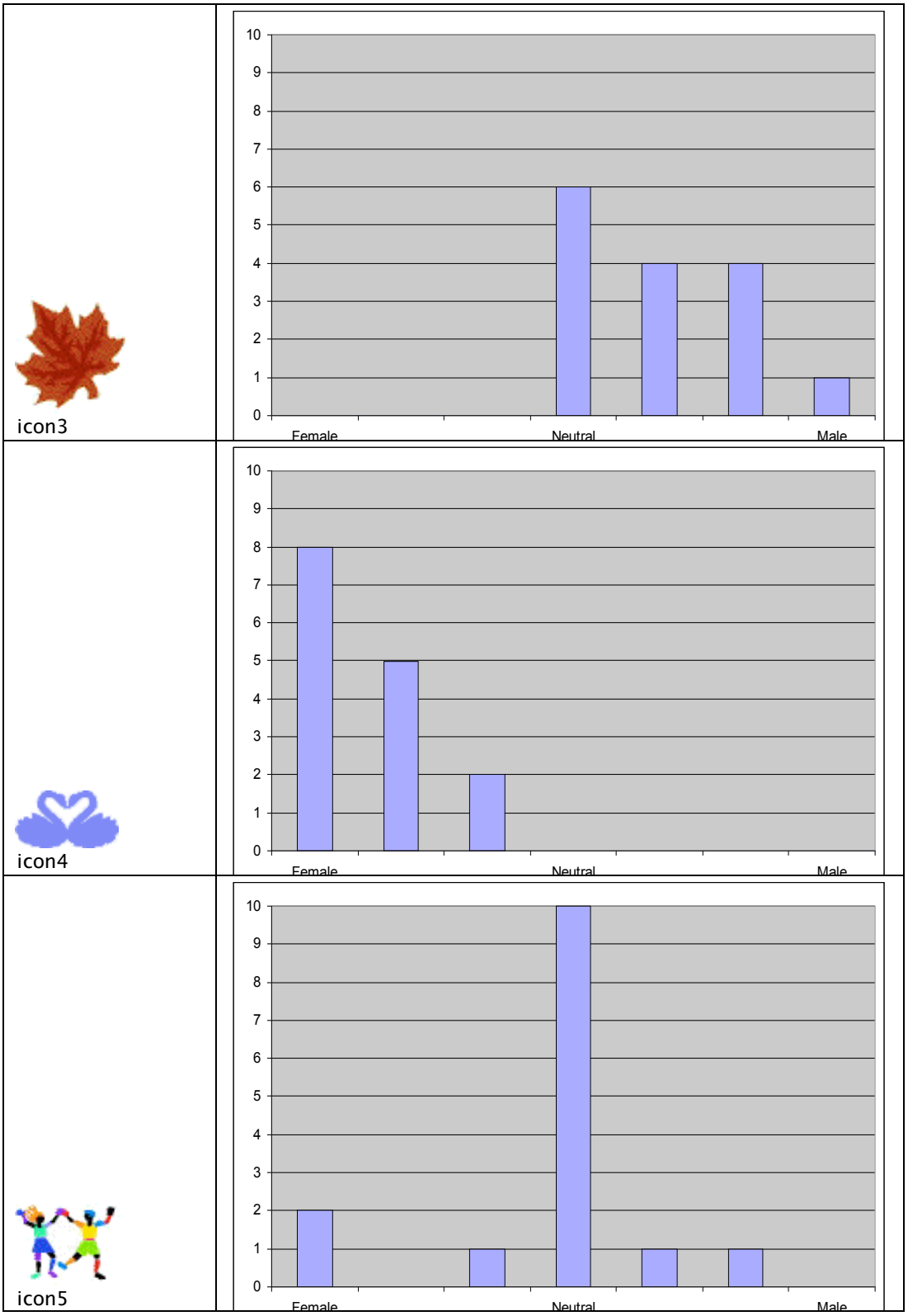
Appendix J (continued)

Icon	Number of subjects	Number of "No" Responses	Health %	Activity %	Relationship %
 icon10	11	4	36	64	0
 Icon 11	13	2	27	58	15
 Icon 12	14	1	21	79	0
 icon13	15	0	27	73	0
 icon14	13	2	35	58	8
 icon15	15	0	57	3	13
 icon16	13	2	46	8	46
 icon17	12	3	25	5	25
 icon18	11	4	64	18	18

Appendix K

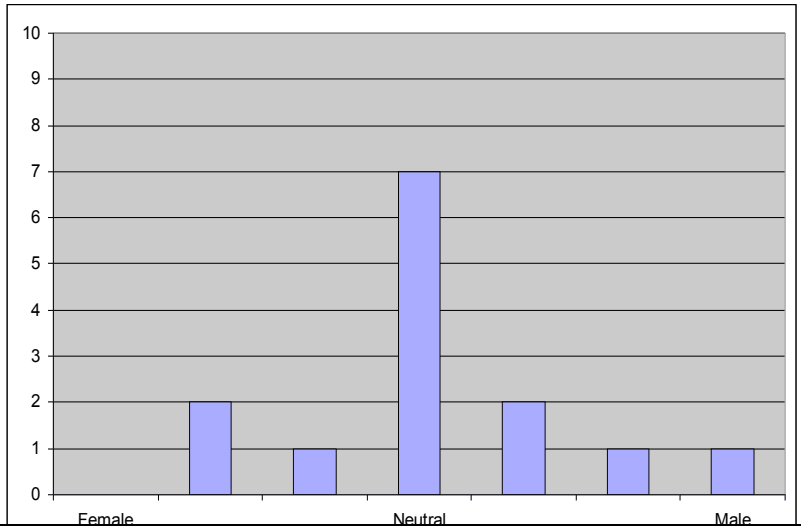
Icon Questionnaire Results: Gender Ratings

Appendix K (continued)

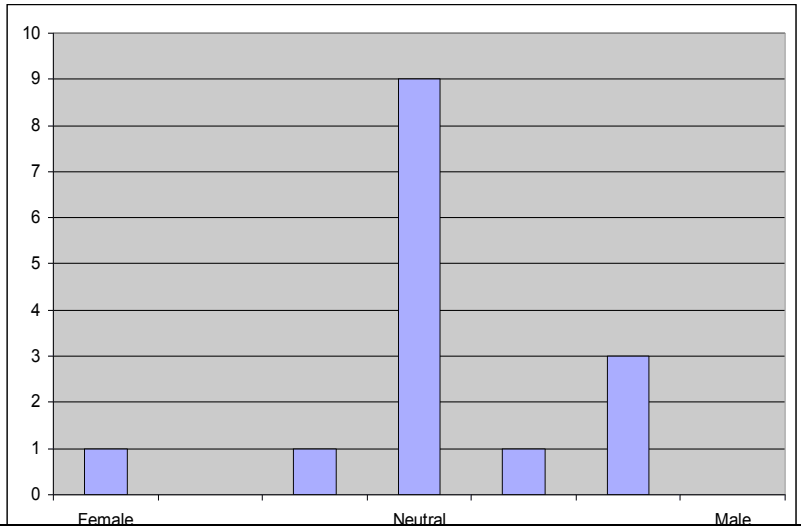


Appendix K (continued)

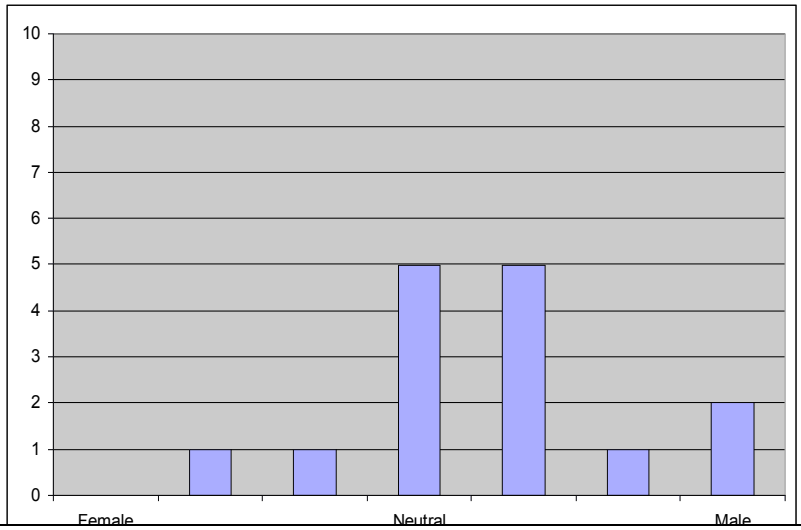
icon6



icon7



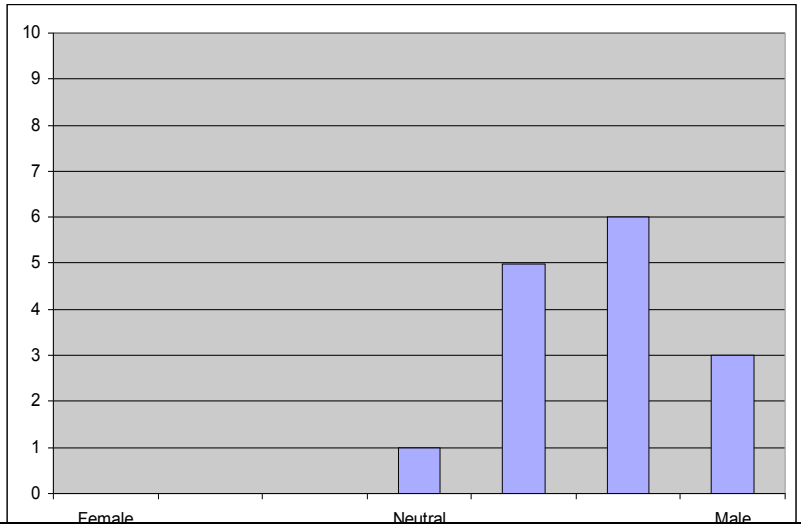
icon8



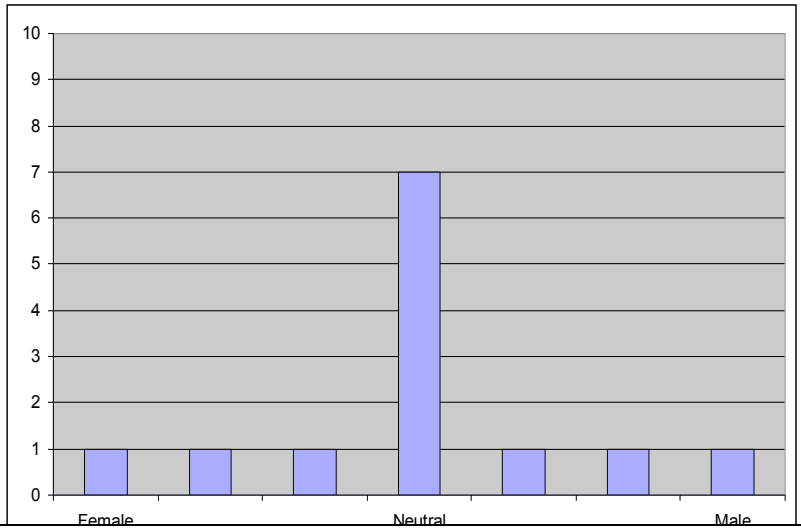
Appendix K (continued)

Appendix K (continued)

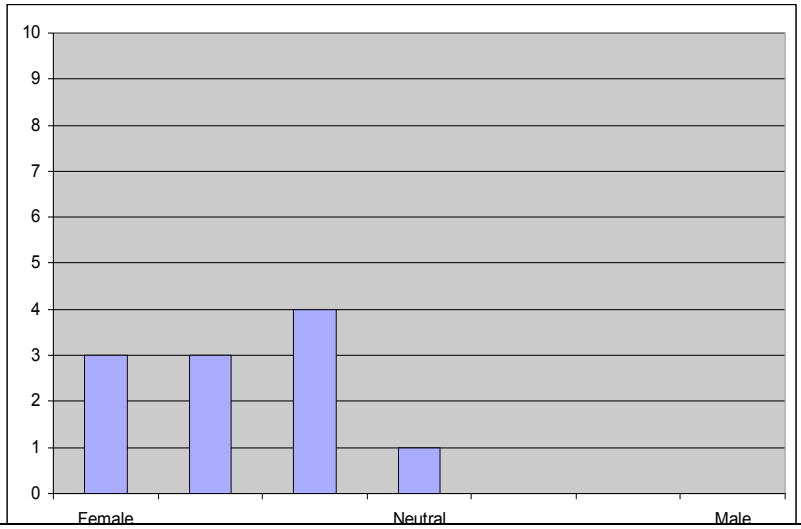
Icon 12



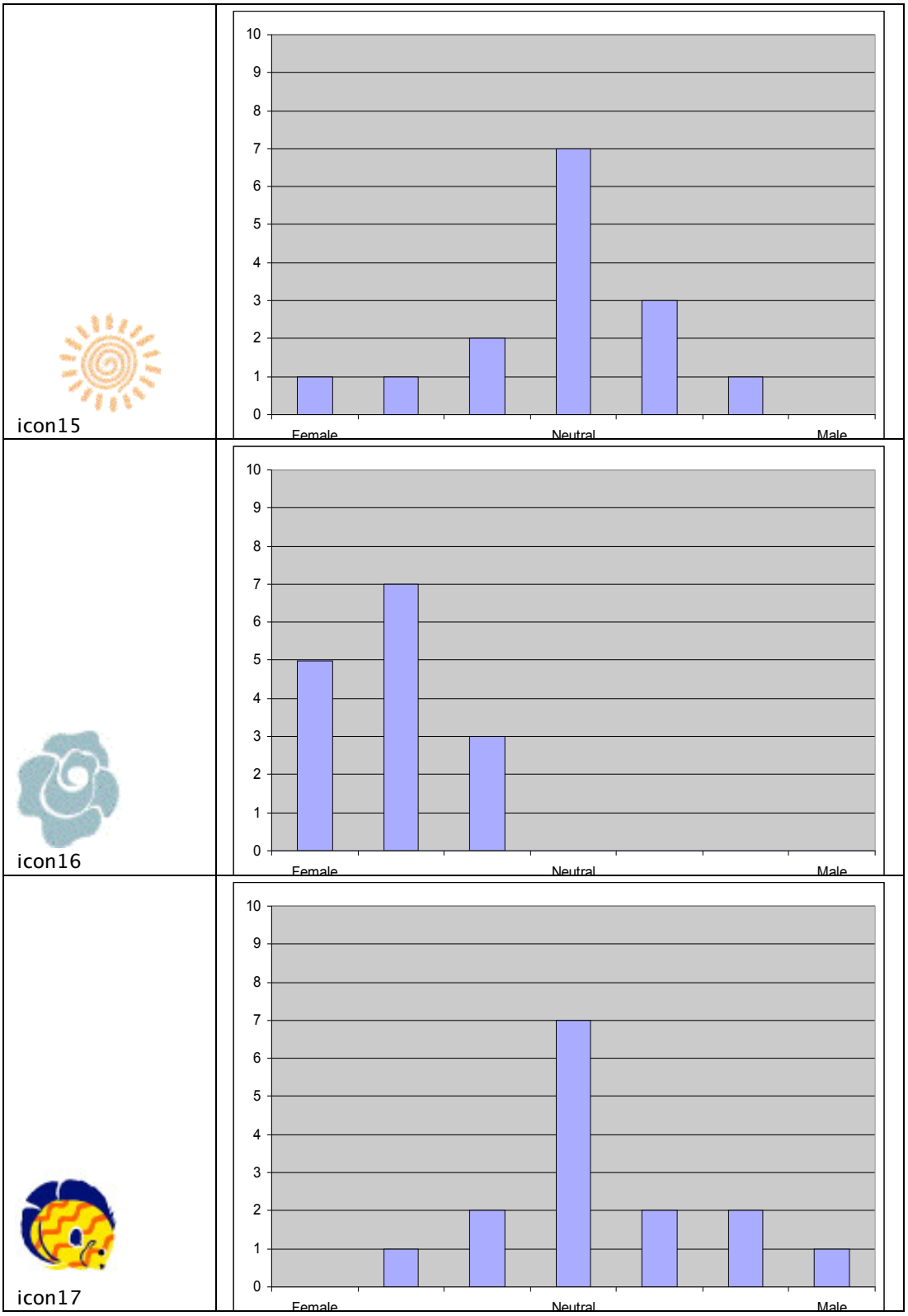
icon13



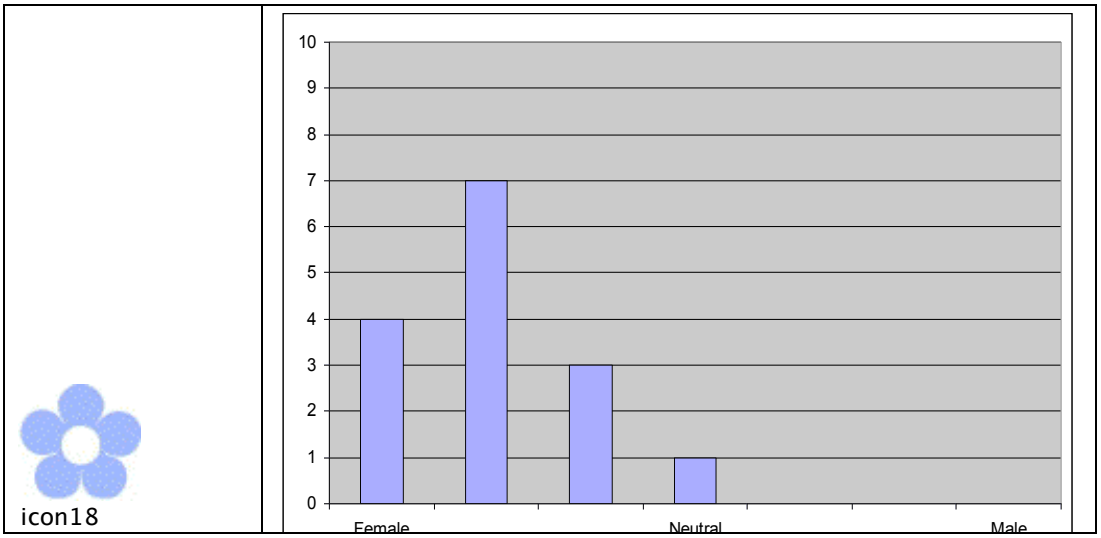
icon14



Appendix K (continued)



Appendix K (continued)



APPENDIX L

Elderly In-home Interview #1

Transcript with Field Notes:
04/26/2000
Wednesday
Jonesboro
Nice clear day, 60's

SURROUNDINGS
Comes to door in underwear
Mobile home
Smokes cigarettes
Navy discharges on the wall
Pictures of family cover the walls and most of the horiz surfaces
Carved 3 foot high sailor on the floor
Picture of navy vessel on the wall
BB pistol beside couch
Penny is in travel pen in the kitchen and can be heard whimpering

PETS
Parakeet
Dog (Penny) JackRussell terrier

INTERVIEW
Venue: Both seated in living room
His days are all "fairly typical"
Gets up at 10:30am
He is a night Owl
Stays up till 2:00am
Takes dog out for a walk "drain her bilges"
Makes coffee
Eats breakfast
Turns on the tv
watches through the noon news (channel 3)
Then fuss around the house
Has painting to be done
He has been procrastinating
He doesn't like painting
Late in the afternoon he gets something to eat
Penny needs to be walked sometime in the afternoon on a leash
Walks around the house

Regrets not taking her on further walks
Neighborhood has small lake with walking path
"We go out shopping if there is shopping to do
Does what needs doing... home depot... publix
"Non-eventful kind of day
We go out in the car after the news (noon news)
He has been trying to exercise
Goes to sports center to try to work out for 30 min
He says he will get back to it soon
Discusses the details of painting his place
He broke his arm last fall while mowing the grass
There is supposed to be a young man mowing his grass
He was unable to get in touch wiht him for a week... vacation?
His feet went out from under him as he mowed the bank
Broke the humorous right underneath the ball Shoulder
No cast... a brace around his body for 4 weeks.
Eats meals at home
4-5pm he eats snack
8-9p he eats again.
Between those times he is around the house... watches tv... He loves TV
He changes around his programming
He goes through the TV guide and around 7:30 he circles all the programs he might be interested in.
He watches the 11 news then Tonight... Nightline... A&E Investigative reports and inside story
Watches the late night tv in his bedroom stretched out on his bed
He likes A&E, Discovery, Learning Channel...
Might call friends during the day... local folks
He gets on computer and checks email when he gets achance
At one point he was "religious" about email but no longer
Computer is in the "junk room
Checks email every day
Email from daughters and a good friend who sends him email [name expunged]
[name expunged] lives in Jonesboro
Daughter in Orlando has 3 kids
G'kids don't do email much
He hears more frequently from his "bonus g'children" out in Dallas
Bonus... [name expunged] (daughter) married a guy who had 3 grown boys
BB gun... neighbor and his wife kept a herd of ferrule cats
Constantly digging up everything... discouraged them from coming in yard
Venue: Kitchen
He grinds coffee beans to make coffee.
He does not call anyone anymore on a daily basis... he no longer cares for their particular

lifestyle
Former friends children are in their 30's and 40's and still living at home... doesn't care for that
Son in law in Florida (Orlando) came up for a long weekend and helped him paint.
Friday and Saturday are different
Friday he dresses up and goes to the American legion for their Friday night party
he gets there 7:30 and stays there until midnight. here in Jonesboro
Saturday they have a dinner at the VFW party and have a good time
Has a "crew" there
Some of the same people at both places
Saturday night goes on until midnight too... on to about 1am
He drives
He dances, drink beer has a good time for himself
Lived in this home for 8 years
Lived in Jonesboro for longer
He was manager of the optiworld in morrow
Was married at that time... bought a house in Riverdale and lived there for 3 years
The yard work was killing him... decided to heck with it, sell house and get a mobile home another mobile home in this same park.
When they lived in this house...His wife "was a nut for flowers and plants
Every weekend we were digging in the garden... plants to take care of...
Up early in the morning and out in the yard...
So they bought a mobile home
She had an aneurism and died
This was his second marriage
Married 30 years to first wife, got a divorce, single for 5 years
He doesn't really have a regular dance partner
At both of the clubs there were an "excess of females"
They will come up and ask you to dance
IT is amazing the number of women who come in just to have a little fun
They aren't looking to be taken home or to take you home
They just want to have someone pay a little attention to them
Widows divorcees...
The carpet is a present from Dallas Daughter
Pretty bird is the bird's name..3 years old
Kids gave him 2 birds for his 70th birthday
Had them both in one cage... she didn't like the male so she killed him
Male is buried in the yard she stays in the cage..
Fresh beans make a difference in the coffee
Venue: Penny is released from cage and put on a leash
A couple times a week he does laundry.. he has his own washer dryer... old but still working...
"She has been a wonderful dog

Venue: Walking dog out on deck
Machines clearing off neighboring lot
There was a house there and moving off all the junk... assumed to make it ready for the next house
Jack Russels are the nosiest creature... she likes to go out to the street and look up and down to see what is going on all over the neighborhood...
This road is really long... he lives halfway
Part of this park is under development
They will have over 900 homes when it is finished
They try to keep it nice and have rules and regs that you are supposed to live by
The kids from Florida come up once a year or so
When they decide they want to see "Papa"
They all camp out in this little house and sleep on the floor
The couch opens up into a queen sized bed
The Dallas family has only come a couple of times
The last time they stayed in a motel... "and that was alright too..."
They stayed here once but I don't think they liked that sofabed
They are used to the finer things in the world
He is a senior VP at Brinks... the head of their TI (Technical Information) department
He travels the world... theya re just back from HongKong
She went with him... he attended a meeting
She flew at no charge... freq flier miles... they spent one week in hong kong, she flew back and he stayed for his meeting for another week
They have 3 older kids... all out of the house and all in computer business
Jeff graduated from college 10 yrs ago
Brent middle son graduated 5 years ago
Spencer graduated 2 years ago
He drives out to dallas to see them three times a year and stays for a week or 10 days
All the sons live in different parts of dallas
He goes to orlando 2-3 times a year
Next trip is the middle of may... one grandaughter is graduating from HS

Venue: Walking around the house
He drives all those trips
Got a regular route to Dallas…

… (interview continues for a total of 9 pages)

APPENDIX M

Elderly In-home Interview #2

Transcript with Field Notes:
04/26/2000
Wednesday
Marietta
Nice clear day, 60's

SURROUNDINGS
Met me at the door
We were seated at the table in the room adjoining the kitchen, not a formal dining room.
Large, open house.
Carefully and sparingly appointed
No pets obvious

INTERVIEW
She has been sick for this month
She lives on one side of the house and her son lives on the other side
They eat together when they feel like it.
They get up when she feels like it usually between 7 & 8 and eat breakfast
When she gets around she does three volunteer jobs that are not weekly
Weekly commitments keep you from traveling
One job is the third Friday of every month and the prior week she has to go to prepare for about a half day
Another job is every other Thursday morning and work
Third job she just started is at church in Dunwoody, every other Tuesday
Fridays she goes to bible study in Dunwoody at all saints church
May have lunch with the women afterwards
The rest of the week she will do laundry and eat lunch
Neighbors from original neighborhood in Chamblee where she lived for 20something years until 5 - 6 years ago... next door neighbor had children her children's age and the woman beside her had 5 children... both are named [name expunged]
One [name expunged]meets last wed of every week for breakfast at a simple place Shoney's because they let them talk as long as they wanted
The other [name expunged]and she have started this too... probably the first wed of every month
Ordinarily she eats at home
One is a widow the other is not
She is never at home except this past month she has been sick
She eats lunch wherever she happens to be
Last night she ate at 8:30 because the spirit moved her

Most normally eat breakfast at home
Ordinarily she goes to the library or she joins AARP classes that meet in the fall for 6 weeks for half a day
She has taken computer classes at Dekalb tech school on Buford hwy
She is never at home it seems
she meets her kids sometimes
[name expunged] works nights and is hard to get in touch with but she does meet for lunch at times
Other daughter in LaGrange when she is feeling well she will drive down to see her g'kids and spend weekend
Only grandkids are 3 and 5
[name expunged]was married but is divorced
[name expunged]is the middle daughter who may not have called me
She surfaces once in a while on her own... she stays busy
She is going out with [name expunged]? and [name expunged]for her birthday
Her son and her went to Pa. to visit her aunt for Easter
Her aunt is 95 years old
She was stuck at the airport because of lightning
[name expunged]lives near MARTA station so on the way back she picked up her car and had dinner with them at their home
They are more structured mostly because of work.. they dont have children
I talked to [name expunged].
She didn't want to go to Pa. because she was sick so she went because her son carried everything for her
Aunt adelede lives in a small town for year s and this last fall moved to personal care
(She sits and taps pencil on desk)
She keeps track of all this with the family calendar that Laura, her youngest gives her every year for Christmas
(Looking at calendar)
She has brother and two sisters in the picture
She was used to her church calendar and kind of misses it but she doesn't want to hurt her daughters feelings
She misses the church holidays on the calendar
[name expunged]and her son in law at their house
[name expunged]is married to [name expunged]
Grandson at Calaway
Her in Paris
She went to Paris with a group from Kiwanis who didn't like to walk in the rain
Her sons best friend got married in south America and she went Venezuela
she has dr. appt planned for August
[name expunged]and [name expunged]and [name expunged]the older and the younger one
[name expunged] [name expunged] [name expunged]
She has something booked about 70% of the time

Weekends are different
When her husband was alive they always went to 7 :30 mass on Sunday
Now she goes Saturday evening
She hangs out at home on the weekends
She has lived in this house since Dec 1993
They built... started building in may and moved in Dec
They bought the land in 1977 but stayed in Chamblee
Before Chamblee in Gainesville for 4-5 years
Husband died in Sept 1993
They both retired on the same day in July and he died two months later
Then his mother died in Jan and father 13 days later.
Heart attack blindsided
Married 42 years
Got married when she was 19
She had 3 teenagers at the same time
No volunteer work on weekends she saves it for herself
[name expunged]and [name expunged]eat dinner out with her
Her son works thru the night because she has one telephone line
He likes to work in on e stretch and when g'kids come they interrupt
Son moved in after husband died
All the kids live in the area
[name expunged]wants her to go back with her... she lives off Briarcliff at Shallowford
Her son went back to school at Ga. State and that's a long commute
when he first moved in with her he was still working in Atlanta
She has an alarm clock that she sets but she wakes before it rings
She shops on old folks day at Kroger on Thursday 5% discount
She usually goes in the mornings
She does all the driving
She is thinking about getting a new car
Her husband liked buying a new car he liked the process
Her sons name is John
When her husband was alive they had family gatherings but no longer
She spends most of her time in the kitchen at the table or in the living room
Her husband spent many years planning the house and the yard
She has someone that takes care of the yard
Her son was never much for yard work
Her daughters do yard work but not her son
She keeps lists of things to buy, a note pad, of groceries
She has categories things to do, things to buy, people to call...
[name expunged]the travel agent, her old friend [name expunged]
She missed the commissioners meeting that she missed last night and she will call someone to see what happened
An old friend that she has not been able to reach.. she doesn't know what is going on

there
Call brother, his daughter has had a baby
Call friends in North Carolina... she does have other friends
This couple here... he worked with her husband, his wife died and he got remarried
That couple and us (my husband) were friends and we still visit back and forth to NC
She has driven herself
She had pneumonia last year so they came her and went tot he little white house and the coke exhibit but they weren't too wild about that
She never drove when her husband was alive, just drove locally
But the only reason she didn't drive last year was she was worried about the age of her car
Another couple friend in Florida and she flies to Lakeland Florida every summer to see them
When friends come to visit stay in her home and she stays with them in their homes
Two or three other couples she used to go on cruises with
She stays in touch by phone but also writes letters
The younger part of the family uses the net
My younger sister is a widow and she talks on the phone a lot
She now uses the computer phone instead and puts up with the delays because it is free
She has a Dr. Laura calendar
She likes the sound of the voice
She got a computer because she thought it was the way of the world and she should do it
Writes nieces and nephews
She prints the email and shares it with family
Never used a chat line
Looks up stuff on the web
Looks up medical information on things in her families life
Asthma,
She claims to be mechanically challenged
When she and her sister were in Ireland every day was a new challenge... even the bathtub was different
It doesnt take much to excite her she claims
No real hobbies... maybe the computer... to start the family tree but her brother is doing so well she is letting him do that
She claims to be busy all the time but cant tell what it is
Her husband claimed that he would volunteer at St Josephs and she said she would go with him
After her in laws died I got all that straightened out she thought that she would try it
She volunteered at the hospital but it did nothing for her personally... there were enough volunteers without her and there was no sense in it
The last thing she started was she worked in a library at church every other …

…(interview continues for a total of 8 pages)

APPENDIX N

Elderly In-home Interview #3

Transcript with Field Notes:
04/27/2000
Thursday at 10:45am I was late by 45 min due to being lost
Another nice day... 60s

SURROUNDINGS
Middle sized house from the 60's
New back room is like being in the woods lots of glass, t.v., two couches
[name expunged] has a prominent nervous tick... head and neck jerk
His wife is there in the kitchen while we talk in the glass room
He is raising his granddaughter

Venue: Started out in dining room at table... switched to sunroom

INTERESTING...
While his wife was in the house she barely said hi and he never mentioned her in our two hour conversation except when asked...
He is Jewish but when asked about holidays he referred to Passover and Christmas

No Pets

INTERVIEW
A typical day varies a bit
He gets up early because he is used to getting up early and he has his granddaughter who is in high school living with him
Sometimes he takes her to school other times she takes the bus
3 times a week MWF he goes to the gym and puts in 1 hour 15 min at the gym
Gym is about 2 miles
Very convenient neighborhood... almost every thing here is within 2 miles
The only thing out of the way is the airport
He reads the paper when he gets back from the gym to see what is going on an event...
He has lunch
After lunch things will vary... he might go sightseeing a bit since he is only in this area for a year and a half
He might work in the house... repairing or building something
Or out on the lawn or just vegetating a bit watching t.v., reading a book
He may pick up his granddaughter or not the school is 5 6 minutes away
He drives
And that's a typical day

Usually eats lunch and breakfast in the house
Occasionally he goes out for lunch... more towards the weekend
He gets up at 6:30am
In the world he grew up in he would get up at 6:30 every day
He moved from NY Westchester county where he lived for 40 years or so
Move coincided with the fact that he could be with his granddaughter going to school
He is retired for about 10 years
Before he retired he was the pharmacy director at the Albert Einstein college for medicine and hospital
Has a Masters in pharmacy and was there for 25 years
Now a days there is no long term jobs which he feels is unfortunate for the companies and the people
He retired for a couple of years in Westchester and then came down specifically to help his granddaughter in high school
He finds the south very interesting
Different than N.Y.... climate... he doesn't have to worry about shoveling snow but the traffic is horrendous and people drive terribly... up north people do stop for school busses down here a lot don't and that's dangerous
Traffic is horrible, street directions are horrible because the use of Peachtree for everything is ridiculous because he spent an hour trying to find an address
On Johnson ferry ... the house here has one number, the house there has another number and in between there is nothing and that is the number that he is looking for
The postman told him "oh that is at the other Johnson ferry down at the other..."
People there don't know..
Boston is no picnic but he thinks this is worse
He watches reruns of Mash on t.v.
In the evening... discovery, history channel, a movie sometimes... a number of different things... he doesn't have any specific thing that he tunes in on
He occasionally goes to the movies... 2 or 3 times
He usually eats dinner at home but occasionally he eats out... once a week in round figures
He has a daughter that lives in Ackworth area
He has another daughter living in Cleveland
Doesn't usually go to bed at the same time but usually goes to bed at 10 or 11pm
He goes to the senior center for dance lessons one day a week
He has friends that he meets with once a month at different houses on the weekend... new people he has met through the Jewish community center and spend the evening
(asked about Different holidays?)
Last week he had his daughter over and she had her daughter over from California and they had them over for Passover services in his home
Last Christmas he was over at his daughters at Ackworth when his other daughter was down staying with her
What else is there? I haven't been there that long...
His schedule is fairly regular during the school year.

He goes around and sees things but you cant go overnight during the winter
During the summer he has a niece that is getting married in Colorado and he is going
He is then going up north to visit some people
He is flying to Colorado, to N.Y. he is driving overnight not that far
He starts out early in the morning and travels until dinner and wherever he is they will stay over
Next day get there late in the afternoon, early evening
He spends the most time
That's a sun room
You go out there and you sit there... (we move)
He opens a window
He built the sun room after he bought the house
He discovered a long deck on the back and it wasn't that comfortable to sit on because stuff fell out of the trees and the bugs would bite him
He had someone frame it in and he spent the next couple of months insulating and completing it.\
They set the windows he set the frames
Comfortable... its a pleasure, you sit out here and watch t.v. and read and have people over
He can be virtually outside because he can open every one of the windows... without the bugs and without being hit in the head
He could spend a lot of time here
He spends most of his time here
He is an eclectic reader/... reads the paper, doesn't read novels... read a number of books on the civil war... being down here (the south)
Read a little bit about the other world wars and about the pyramids
He makes a list of things when he goes out shopping... lists of things to do or get
He doesn't sit and plan as such
He does a little planning in the summer... planning what to do
He goes north to Tallulah gorge for picnic
He likes it there
Just recently he got a rubber raft he wants to take to Chattahoochee river
He is a member of the Jewish community center and goes to the senior center
He might want to do some white water rafting and such
This is his second summer here
he got there Sept. of 98
(The birds are singing outside)
Two squirrels chase each other out there and they really have fun
Except for the fact that they eat everything you put out
They had these little plugs and seeds from the Shakespeare gardens in England but the squirrels ate them all
He didn't take his granddaughter
He took a tour.. in the past he didn't take a tour but now he is a little leery about scouting

out his own things
There is more security on a tour
Go somewhere where somebody knows the language... if you don't its kinda rough
He was in Portugal some years ago... nobody spoke English...
He is more afraid and he would tend going on a tour.
Hospital was in the east Bronx not too far from the zoo
His daughter worked for ATT at Basking Ridge
He is not a golfer... he'd like to play volleyball
He likes to spend time building things like the room
He walked the short walk at Tallulah falls
It took him a long time to find the place
They don't say information center they say something else
The signs were wrong
They go on a trip or a cruise every year
The change is something to look forward to and is very good
It is something that he can reflect on
He did a student study on aging at GaTech
He has a computer that he uses a little for email
He is not big on email
Years ago you used a pencil and paper, then you got the typewriter, then you used the telephone and now I'm going back to typing?
Thinks email is fabulous when you need something faster
He uses a fax machine... he has no desire to type it out
He gets more email in than he sends out
Emails his brother in Colorado
He ends up writing or faxing
He regularly types on the computer, prints it out, signs and mails it.
He will use the internet for maps but he doesn't use internet for much
G'daughter uses it for school
He does some yard work... in the fall there are plenty of leaves to rake up
There are plenty of leaves back here... he has a burning pit for the leaves
He has a chainsaw... years ago before he went into hospital pharmacy he was in retail
Which was also not exactly the thing he wanted to be in but when he came home at work he built his cellar up... it was good therapy... why pay a therapist when you can get something out of it?
Most of his work was mental stress
When you get into doing something with your hands it…

…(interview continues for 11 pages total)

APPENDIX O

Elderly In-home Interview #4

Transcript with Field Notes:
04/27/2000
Thursday at 2:10
Interviewed husband and wife together...
[name expunged] is tethered to an oxygen generator

SURROUNDINGS
Horseshoe Bend
We met in their den, I have a picture of them there
The neighborhood is very large (1200 homes) golf-based recreational neighborhood to which there are only 2 controlled entrances and three lakes.
There is a Puccini Opera playing in the background
Lots of various kinds of cuckoo clocks...

PETS
They are caring for one of their children's dogs.

INTERVIEW
(I explain a little about the project)
(I ask about a typical day)
(Joy talks) Thursday (today) is the first day that she has been home
They both volunteer at the governors mansion once or twice a month
She tap dances twice a week
They walk the dog a couple of times a day
She cooks and eats the majority of meals at home
They eat out only occasionally
They go to the olive garden for salads and stuff
They now go to bed earlier than ever before... 10PM after the dog walk
He isn't a t.v. person unless it is a sport or news
She likes old movies and watches them in the bedroom when he is watching sports
They "keep busy
Very active in the church, a local church
Before that they were members for 35 years that is located in a "changing area" and the congregation dissolved
They were down to 25 people...
We gave our church to the synod and there is a Hispanic mission there... there were a large contingency of Mexicans that were starting to come
This church is in Doraville
She doesn't really have a typical day

Every other Friday she goes to a meeting of an international women's organization... during the day
A little housework, a little cooking and some social life,,, the days come and go and they go pretty fast
He sets an alarm... he has to get the birds up
[name expunged] protests that he does not set an alarm clock every day... if we have something to do in the morning then he will set it
She says that he sets it for 6:30 because if they have something to do it takes him a couple hours to get ready (emphysema)
They are usually up around 6:30 when they work at the governors mansion
If [name expunged]? and I are going dancing then I am up at 8
This morning he slept in till about 8:30
They are docents at the governors mansion
The public can visit the governors mansion for free three days a week
They work with the same group of people when they work at the mansion
She usually does the state dining room and he usually does the family dining room
[name expunged]) We share with the visitors what is unique about that certain part of the governors mansion that we are assigned to... there is the library, the family dining room, the circular hall, the state dining room, family living room, state drawing room, guest bedroom which is on the first floor
Jack)There is one person to meet people at the front door... there are usually 8-9 people involved
It is open Tue wed Thu from 10-1130. They leave at 8:30.. it is off of west paces ferry
She will be volunteering at the decorators showcase house tomorrow they do this every year...
It is in the benefit of the symphony... they were members of the symphony but they no longer have season tickets
They belong to the ensemble theatre which is an regional theatre they have season ticket to that
She tap dances with seniors that entertain... not clogging.. she has done this all her life... she has been a part of this group for about 10 years
It may go under soon because their instructor is 79 and is having some leg problems
This group is in Chamblee
Instructor is in Roswell... there are 6 in her group...t here were 10-11
[name expunged] writes all the checks since he retired... She had done it for 40 years
[name expunged]) Yeh well we just reconciled the checkbook this morning and we hit it in a heartbeat... he is very diligent about it making sure the entries and the mathematics is correct because if it is my fault he is in big trouble
He handles the insurance and the bills ,,, figuring out what the carriers will cover and what they owe...
[name expunged]) This is part of my typical day... shoveling paper around... he thought that when he retired that he would get out of that atmosphere .... he lost... you never escape the paper trail

Their daughter lives in a townhouse and is not married... so that every thing that happens its... "Daddy... there's a squirrel in the attic.
Daughter has a townhouse in Brookhaven
She is gainfully employed...
[name expunged]) She was a little disappointed that the original thoughts about=... you know....
(I explained that this is a start of the research)
She will be very interested in working on this
[name expunged]) She is an articulate person so she will
She is a producer-writer working in t.v.
Have a son in Dallas They refer to their son as "[name expunged] "... they moved here when he was 14
He graduated from Auburn ... War eagle...
[name expunged]) He is still a big supporter... he graduated in 1974 in December... He is not great in math... He got a business degree..
He loved auburn... those were the best years of his life... his frat brothers to this day... Lambda Chi
[name expunged]) it was on the main drag down from Samford hall... down a couple of blocks
Now there is a brand new one...
(I talked Auburn for a while with them... Samford park)
This is what a campus is supposed to look like...
My relatives went to UGA
Grand dog is the only grand kid
Well we aren't going to have any because my daughter.... she has God Children...
[name expunged]) The teenage years are a difficult time with children that age I could offer a lot of advice
We didn't have any trouble... Jay said he was not any problem and she said well you know... you are right...
[name expunged]) Neither one of them was any problem... The worries were a lot of it. If I had a daughter now I'd be on my knees praying...
[name expunged]) Boys are easier to raise than girls...
[name expunged]) I have been retired 11 years the first of this July... He spent 36 with 3m in sales and sales management... started in their retail tape room in Columbus Ohio where he was raised... then he moved to west Virginia in the same capacity and stayed there until 1966 when he moved to Atlanta in January ... he transferred into their medical products ... had some hospital products... probably for 3-4 years at that point(young line of products) and there was a better opportunity for advancement...1974 went to Philadelphia as the result of a promotion... and was there for 4 years and then came back here as the result of another promotion
[name expunged]) and finished out his career here in Atlanta
[name expunged]) [name expunged] works at 3m and ;has traveled for them for 21 years... he's 48 now..

He was born Sept 21 1951!!!
Well... I could be your mother so watch it!
[name expunged]) He received the offer on April 1 1976 and he thought it was an April fools joke... of course he interviewed when he was home in Philadelphia for the holidays... he took some tests... and they needed somebody that spoke southern...
And [name expunged] didn't have anything to do with it...
The daughters name is [name expunged]...
The four years that they lived in Philadelphia Jane was at UGA and we could have bought Delta airlines... and the telephone company...
We came back to Atlanta right after she graduated
[name expunged] didn't have anything to do with it ... it was in an entirely different department
[name expunged]) [name expunged] told me about an Opening that they had... He said Jay will be home over the holidays... you could interview him... that was the last contact that I had with that guy
He was not the type that would try to make points with jack...
(asked about weekly schedule)
They go to church Sundays and Wed during lent
They are Lutheran
They are looking for another church... she wants to go to Redeemer Lutheran
They have also gone to another in Dunwoody... she wants a big church where she can get lost
(talked about Lutheran church)
[name expunged] Subdivision fees are $271... but there are 1200 homes
They both played golf because of [name expunged] illness... it was really expensive
He was a big gardener but he cant do that now... with his illness
[name expunged]) She had a big yard sale with her daughter Jane...
He sold the mower and edger.... they have a yard guy... he put in an irrigation system and is going to put in Zoysia grass... they just had all the pine trees cut down in the back to get more sunshine in for the grass
He sits at the kitchen table and shuffles his papers and I sit at my desk... I write a lot of letters and notes... I am a big correspondent
[name expunged]) she is a .... she probably sends 15 -20 cards per month... birthdays, friends, people we graduated with... High School in Columbus Ohio... The reason I know this is that I buy the stamps
She reads... author about England and Ireland
She doesn't like action things.. she likes good books... she gets national geographic and house and gardens
[name expunged]) Get things from the High museum and…

… (interview continues for 11 pages total)

APPENDIX P

Field Trial Elder Parent Pre-experimental Interview Guidelines

Parent's Pre-Experimental Interview
Today's Date:_____

This is an unstructured, open interview that strives to get at the nature of the existing parent/child relationship. It will begin with the following probe:

"Would you please tell me about your relationship with your son over the last year."

Questions that may follow that request include:

How frequently do you interact with your son?
Who initiates these interactions?
What forms do those interactions take? (phone calls, emails, letters, postcards, personal visits, dinner together…)
Who else do you regularly talk to?
How aware of your day to day activity is your son?
How connected do you feel to your son?
How connected do you believe he feels to you?
Currently, who would notice if something was "not right" at your home?
Do you ever avoid telling your son something to keep him from worrying about you?
What about you do you think your son keeps track of?

APPENDIX Q

Field Trial Adult Child Pre-experimental Interview Guidelines

Adult child's Pre-Experimental Interview
Today's Date:_____

This is an unstructured, open interview that strives to get at the nature of the existing parent/child relationship. It will begin with the following probe:

"Would you please tell me about your relationship with your mother over the last year."

Questions that may follow that request include:

How frequently do you interact with your mother?
Who initiates these interactions?
What forms do those interactions take? (phone calls, emails, letters, postcards, personal visits, dinner together…)
Who else does she regularly talk to?
How aware of your day to day activity is your mother?
How connected do you feel to your mother?
How connected do you believe she feels to you?
Currently, who would notice if something was "not right" at your mom's house?
What kinds of things about your mom (health, activities, schedule…) do you currently keep track of?
Are there things that you are aware of that she tries to keep from you in order to keep you from worrying?

APPENDIX R

Field Trial Elder Parent Post-experimental Interview Guidelines

Parent's Post-Experimental Interview
Today's Date:_____

This is an unstructured, open interview that strives to get at the nature of the parent/child relationship when Digital Family Portrait is available. It will begin with the following probe:

"Would you please tell me about your relationship with your son when the Digital Family Portrait is in use."

Please talk about how you used the Digital Family Portrait since its installation.

Were you concerned about being monitored? (if so) Please talk about that.

Where there any surprises?

Did you have any insights, comments or final comments concerning this technology that you care to share?

Any final thoughts?

APPENDIX S

Field Trial Adult Child Post-experimental Interview Guidelines

Adult child's Post-Experimental Interview
Today's Date:_____

This is an unstructured, open interview that strives to get at the nature of the parent/child relationship when Digital Family Portrait is available. It will begin with the following probe:

"Would you please tell me about how your relationship with your mother changed when the Digital Family Portrait was in use."

Please talk about how you used the Digital Family Portrait since its installation.

Was there a particular part of the Digital Family Portrait that you used more frequently?
Was there a particular part of the Digital Family Portrait that you found not useful at all?
Where there any surprises?
Did you have any insights, comments or final comments concerning this technology that you care to share?
Any final thoughts?

APPENDIX T

Field Trial Elder Parent Pre-experimental Interview

Introductions
Wednesday Feb 18 2004
Talk about your relationship with son over the past year.

We've been together over the past year more than normal because he was not working (retired) and he comes down here fairly often

Average of twice a month, maybe not quite that much sometimes,but mostly, sometimes it's two three or four times a month and we have a very good relationship

He does now have a job and maybe won't be down quite so much for a while, but once he gets settled into it I think he'll be back.

(interviewer)So, uh, he retired?

He retired.

(interviewer)Was that about a year ago?

A year ago January at least that long ago

(interviewer) SO he comes to visit… does he call on the phone?

Oh, very often…

(interviewer)Would you say that very often is once a day, several times a day…

I would say it was two or three times a week.

(interviewer)Who normally initiates the call?
Either one… I initiate more than he does but he frequently will call me
And we both have answering machines so… we communicate that way sometimes.

(interviewer)What about um, I know that you deal with email…

Yes

(interviewer)And so doesYour son… do you use email?

Not very often with him I just haven't with him…
I have two daughters who live farther away and I email them more often.

(interviewer)OK now where do they live (the daughters)

One is in Kansas City and the other is in a small town west of minneapolis

(interviewer)So email is good for that

Email is good for that but so is the telephone… I use the phone a lot.

(interviewer) Do you talk on the phone a lot… do you get together frequently?

Not as often as I would like sometimes but um couple times a year we get together… it's hard to make arrangements to get together with busy families

And as you know I have been making a couple of extra trips to california

(interviewer)Yes

(Which is under control)?

(interviewer)Do you go to his house?

I haven't been to his house as often as I used to because he has other people living there for now.

(interviewer)Oh that's right…

He rents out bedspace or what ever and I don't go up there as often… I used to go up there fairly often because I was the one retired.
Then when he retired he comes down here

(interviewer)I asked how frequently you talked… did I ask you how frequently he comes to visit here?

Yeh. He comes a couple times a month I'd say.

(interviewer)Is that … over the past year it hasn't mattered that much… but is it the weekends?

Oh no, it could be anytime over the past year… now we'll go back to over the weekends.

(interviewer)He just recently got this new job didn't he?

A week and a half ago

(interviewer)Is it full time? I haven't even talked to him since then

It's full time… yes

(interviewer)It is? I'll find out more tonight… I'm talking to him tonight.

Are you? I think it's full time .and uh

(interviewer)DO you think he is happy about that?

So far… so far. It depends on how it goes… it's pretty new yet
But he likes to keep working… he doesn't want to waste his life sitting around

(INTERVIEWER)
Um…. Let's see… Who… Do you make phone calls regularly… Uh… who do you normally communicate with aside from your son? Do you have people that call you? Do you call ppeople?

I regularly call my brother at 9pm every night unless one or the other knows we are going to be gone. And then he is has a phone(?) and he doesn't aswerr the phone, I worry.Because he lives alone and he's 83 and uh I check on him

(interviewer)Does he live locally?

No in chicago area

(interviewer)What about other folks?

[rsib}I have a sister in Ca. Who I have visited several times lately… I talk to her usually twice a week either Wednesday or Thursday and on Sunday
And I have a sister in illinois, Streeter Illinois. That I talk to one or two times a week

(interviewer)And it's 50-50 who calls who?

Yes

(interviewer)But you always call your brother?

Yes although he will call me sometimes, usually he forgets or has fallen aSLeep before he

was to call or something… but I call I just check on him

(interviewer)That's all family.. what about non-family

[rof]I don't keep in touch with anyone regularly

(interviewer)No organizations?
What about neighborhood?

No uh uh, not really.
I see them in the summertime a lot more than I do in the winter time but I don 't contact them by phone very often.

(interviewer)So uh Let's see…

Just to comment I would say I live a very quiet life… my only outside activity is church activity and that's on Sundays and wednesdayy nights

(interviewer)And that't usually involved with going to the churrch and meeting people there

Yes

(interviewer) you don't converse with those folks outside that?

Sometimes but with no regularity… nobody's checking on me and I'm not checking on them… just if there happens to ve something of interest that we want to talk about.

(interviewer)So…

And one more thing that I do do regularly, so that you have my pattern, contact.

(interviewer)I know htat you play golf…

Occasionally… I'd like to play more

(interviewer)You don't get the time? Or…

I don't get the opportunity to play with someone

(interviewer)Oh Yeah… you don't play by…

… (interview continues for 8 total pages)

APPENDIX U

Field Trial Adult Child Pre-experimental Interview

Note concerning transcript: M carriage return is me, the interviewer.

Adult Child interview taken in the evening 2/18/2004 in his home

M
Today is wed 2/18
What I want to talk about and what I want to get to
To get them on tape and to make sure I have everything covered
Tell me about the relationship
What kind of
Lots of different aspects of the relationship that you currently have with your mother over the past year or so
So
How does that take place
Who inititates
How do you inititate
Do you talk frequently or not
Those kind of things
That's what I'd like to get at
To start with really I want to ask you to describe what your relationship with your mom is

It's a fairly close relationship in my opinion
She lives fairly close in peachtree city
Approx 50 miles from here
Talk once a week
Got to pc to visit approx every 3 weeks
Converes about topics of the day
Events in the news things like that
Frequently do errands or tasks for my mom when I'm at her house
Repair things that need fixing
Help with something that's broken things of that nature
My mom is still in pretty good health
And mobilitiy and gets around a good bit
She has a fairly active life in pc
Where I'm not concerned on a every day basis of where she is right not and what she might be doing
More along the lines of touching base with her checking in

If I'm about to leave town let her know when I'm going to be gone
Versus any kind of more concern about her hurting herself of injuring herself or not being able to take care of herself

(interviewer)You said phone calls, who initiates these phone calls

I'd say generally she does but it's a back and forth kind of thing
I'll occasionally call her as well
And of course answering machines, when we disconnect I will call her back
And she probably vice versa

(interviewer)So you said you also visit occasionally do you inititat e these
Are they fairly regular or do they just seem to happen every 3 weeks

Kinda seems to happen
Occasionally there wil be times when I know I want to go get something done and
Hooking all this equipment up and getting things working I have had occasions
To go and attend to the computer at the other end
And get some things in place to get remote administration a little easier
Just one of the drawbacks we have to go through
Doing things with that
You know
Occasionally I will be working on something in her house and need to take a trip to home depot and go down and take some jack posts down to shore up something in the crawl space

All in all it's probably inititated more on her part than me with the communication events but a fair precentage from my side going the other way.

(interviewer)Have there been situations when the equip has messed up and you called down there and had her do something

Oh yeah the infamous reboot
Actually until I got to where I could remotely mount the disk drives on that system I would call up and have her look at a log file in the early days of debugging and painfully step through that process
She has read things that she didn't have a clue about and got me down to the point where I could decide oh this is what happened and try to make a fix
She has been very willing to participate in that even though she is kind of uncomfortable messing with that stuff
She would could follow the directions and doo all the things that need to be done

(interviewer)You talked about phone calls

Visits and so forth
You guys go to dinner or go to things together

Yes when I'm there
Of course a lot of times I'm there to get the home cooked meal from mom
Other times we'll go out and eat dinner locally
She doesn't come up here as much as she used to
It used to be that she would try to come to atlanta
I guess a day a away from pc or something
But over the course of the last couple of years I'd say she is stayin ghome more and I'm going there more
But yes we do go out to dinner though I wouldn't say we have done anything other than dinner not a whole lot of other things to do down in pcbut uh

(interviewer)So you both use email
Do you email back and forth or is that something that you handle some other way

Igenerally don't email her too much
Sometimes I will get something from one of my sisters that I will forward on to mom or if I find some information on airlline sales plane tickets I'll forward that on to her
But she isnot a religious email reader and so I don't want to clutter her mailbox either
And just send her anything
But I am encouraging her to stay active and internet connected and hone her skills there because if she becomes more confined to the house this would be an avenue to see the outside world if she were more comfortable or at least had some degeree of comfort using it.

(interviewer)Who does she ususally interact with

She is very active in her church
She does proof reading for a company that prints bibles so she frequently has a stack of work that she has at home
She proof reads and corrects and carries the hand marked documents to the company and they give her another stack
This way she can take on as much work in her retirement as she chooses in that way and she can get her some extra mad money to take various trips with or what ever she chooses to do with it.

(interviewer)What about family members
Does she keep in touch with family members besides you

Yes
Religiously

Of course I have two sisters who probably calls or they call her weekly
They are further away in kansas city an dminnesota
It think the lack of convenient way to get hold of mom any other way means they call via the telephone
They all have events in their lives going on with their children that are things that they talk to mom about so there is natural conversation in regards ot the latest with a neice or a nephew
And some of the older nephews and nieces are involved with the conflict in iraq
Therrer is a fair amount of conversation about where is jessica now and things llike that
And then she also is very close to her brothers and sisters
And her sister has a son who has had a virus called the …
The name escapes me but he is parallized now
So she (mom) is more concerned with the health of her sister who is trying to care for her adult child in a convolescent center when the insurance has run out
So there is constant phone calls trying to keep up with the health of chris and
My aunt phyllis, the sister to my mom
So there is a lot of phone calls there
And she religiously calls her brother at 9pm in the evening

(interviewer)So where is her brother

Her brother is just outside of chicago
And the sister is just outside la

(interviewer)So she calls the brother every night

Or he'll call her
There 's some exchange of who calls who

(interviewer)Sounds like she stays connected pretty well
What about people in her neighborhood

She speaks of the neighbors
I know a couple of them but jjust barely
Probably my fault for not getting more involved with her neighbors
But the people next door I know
I know the names of the people on the other side
If there were any problem I could contact them an dhave them check on mom
Or if mom was away and there was a problem I could get them to check on the house
And she I don't know if she interacts…

…(interview continues for 10 total pages)

APPENDIX V

Field Trial Elder Parent Post-experimental Interview

Interview with elder parent 2pm Wednesday 4-28-2004 at her home in p'tree city.

(interviewer) (Introduction)
(Discussed dfp in a box and it's differences from this field trial)
(during htat discussion this came out)

[p] talked at one time about having cameras up in the corners and I wasn't too keen on that

(interviewer)why wheren't you keen on cameras?

I just didn't know that I wanted a camera watching me

(interviewer)You won't be surprized to find out that you are not alone
That's one fo the first questions that come up
I have some questions I want to go through ()
So tell me about the relationship between you and your son over the past couple of months during the time that the dfp was in use
Do you find any differences, similarities, change at all, no change

Um
Not necessarily any change
But I would say that I feel more comfortable knowing that he knows that I'm moving around
He knows that ther's something going on down here
And if he doesn't get something with a malfunction, he calls

(interviewer)So this has happened?

Oh yes that has happened
Not often but 1 or 2 times he has had to call to have me go in to do something to the computer
And I don't even think about it any more.
No I don't think about it at all
But uh if I'm feeling lonesome, I think oh well your son knows and so then I don't feel so lonesome.

(interviewer)So even though there is no…

There's no communication I just know that every night he checks it

(interviewer)Is this something that you know that he checks
Or you know because of the study…

Well I know that he does it
If there's something wrong he calls
And it's not me, it's the computer… so far…
I've been fine

(interviewer)Is there anything else about
Do you think…
So there have been more phone calls
More communication because of the dfp

Well, just a couple over the two months that we've done it
We've had other conversations but those would have been the normal conversations that we would have had anyway
We get together once a month probably for lunch or dinner
We do some things
But that pretty much
I'd say we get together about that much any time

(interviewer)So you mentioned something about cameras…

Laughs

(interviewer)Do you have any concerns about the way you are being monitored the way we are monitoring you here?

No none at all

(interviewer) You don't feel there are any privacy issues

[p]I don't feel imposed upon,
Or spied upon or anything
He might wonder sometimes if I'm maybe being kinda lazy
I'm not sure
He hasn't mentioned that but
I get out here… once I come out here then you lose me (in the sunroom)

(interviewer)No there are sensors

Oh that's right then he probably knows I'm working on that (the editing)
But every so often I could be working on this (her puzzle table)
Right near by
But in the winter time it's in there

(interviewer)In the dining room?

For part of this study I was working in there (dining room) because it was too cold out here (sunroom)

(interviewer)Did you change it according to the weather

I changed it sometime in the past 4 – 5- weeks over the 8 no 6 week study
So sometime during the study I moved from in there(dining room) to out here (sunroom)

(interviewer)This is kind of an annual cycle that you go through

Yes
And it gets brighter out here
The light is much better out here (sunroom)

(interviewer)Yeh you don't have to have any light at all

Well, I still have that high intensity lamp
Because it is small type
I'm glad to take a break

(interviewer)During the study period were there any surprizes that came about
Any surprize communications?
Anything suprizing that you can think of

Nothing that I can think of..

(interviewer)Maybe keep that in mind and something will come up during the interview
So during the study time are your son's siblings aware of the dfp test?

Yes
They have been aware of it
I don't know if they have talked to him about it

(interviewer)Have they talked to you about it

Every so often
Not a lot
We were more concerned when I was talking to them about their children
3 of them are back from the war
all 3
jessica got out of falluja a week before all this started.
She could have been right there
I am so glad
She's at home now

(interviewer)Is there a chance she'll be cycled back out

Well they are in the army reserve and the national guard so could be…
They are not regular army but they are all home now

(interviewer)So where does jessica live

Minnesota
She was the last one

(interviewer)Um
When you talk
If you mentioned to the kids or they mentioned it (dfp) what did you talk about.
Do you remember?

Gee
We had talked about it before the test actually started
Jess was talking about it… It was here
There was one time when marge was talking aobut it
Now why was that

(interviewer)Marge is in california

No marge is in kansas city
I can't remember why but
She was very interested in it
She was very pleased that we were doing it
It puts her mind at…

…(interview continued for 17 total pages)

APPENDIX W

Field Trial Elder Parent Post-experimental Interview

Note concerning transcript: M carriage return is me, the interviewer.

Adult child post experiment interview 02/28/2004 7pm Wednesday

(interviewer)Tell me about how the dfp, when it was live, affected or did it affect the relationship or the way you dealt with your mother or the way you communicated with your mother
There were lots of technical issues on the site and we'll…

Ignoring those…

(interviewer)You've given me quite a few notes on those already and a lot of issues can be resolved by hardware upgrades and there are a lot of issues that are software related and…
Right now we are trying to get at the experience of using it assuming that it was working exacctly as we were expecting it to …

I think that if it had worked morel like what I had expectec it would have been a more useful tool. As it was it was a little bit harder to get at the information that I wanted to know..

(interviewer)Was that a design issue or was that a performance issue

Mosttly a performance issue… and then the bugs where funny things happened and we had to start over…
In thinking about it I think the ultimate target for this is a picture frame type device so that it is always up and always abailable and you can go up and tap to drill down kind of thing…
That's probably the most useful experience to me is to come in on days where I don't suspect that there is anything I need to worry about at mom's
Get a quick read, activitrty level is not extremenly low or different than I expect it to be and go on.
That can be accomplished with a hardware upgrade or refinements to the application code.
But as it was it was harder to use in it's current state.

(interviewer)What…. Could you tell me what parts of it you used um…
Let's put it this way…
You know all the different parts of it … what kind of things did you look for?
Did you
When you did a drill down what were you looking for If you used the slider what were you looking for

I found myself
I thought I would use the slider more initially but part of the shortcomings of it was that the slider wasn't clear enough to tell me how she was moving about the house
So I found myself looking at the bar chart at different activity periods throughout the day and at different times when she was away from the home
And try to make some assumptions as to where she might be and things like that
So that turned out to be the more useful thing because it came up immediately when the drill down came up
And frankly I used it a little bit to look at the sunrise and sunset values to set the timers on my outdoor lights. (a couple of sentences on this)

In general, the other features, the weather, sometimes… I'm living close enough to know what the weather is so it was not that much of an enhancement or feature that I would benefit from…

The slider I hoped would be a little more accurate or a little more ?

(interviewer)What would you use the slider…
It was a performance issue, right?

And the granularity of detail

(interviewer)Suppose you had something like a "play:" where you could drag it to a point and hit a button and watch it play Is that the kind of thing you are looking for?
I was trying to get a feel for how she was moving around the house…
The sliders intent was to show different sensors activatedand your limited granularity in just trying to move it freehand was too course to see what was going on

Another thing Iwas trying to do with ti was to get a feel in my mind tas to where the sensors firing correctly

I was looking for a validity test on sensors to say hey… did motion track in nice linear pattersn or did it bounce all around the house?
And it was too course a grranularity to do much with that but the ultimate goal assuming all that worked would be to try to make some inferences about what mom was doing as she moved about the house.

(interviewer)Did you intentionally look at any days in which you knew you were there?

Yes I looked at one to see if I could see what the impact of multiple sensors going off at the same time and I could not tell from the slider…
I didn't know… it looked like there was more activity in a period of time but I could never get it granular enough to watch one sensor fire to the next to the next to the next

(interviewer)A "play" would have solved that I think

That or a single step with a… hit the arrow key and it moves from one to the next to the next or something along those lines
Those are all features or enhancements

(interviewer)Was there anything about the way the information was displayed
The background…
You know there was a green and there was a blue
Did you notice anything in particular about any patterns or any particular days have any particular pattern that you noticed or
Do you think there are patterns for days?

Several times I would notice that the previous history was not allighned with the current day
I'd look and say… ok… looking at the 3 week drill back on Wednesdays the came humps were over here and today's activity was in the gap of that
I wasn't able to make any inferences from that cause I didn't know what she was doing today versus those days and that may be something
I don't know how to add intelligence

(interviewer)My didn't have any opportunity to talk to your mom about those particular days if they were different in any particular way

No um because ususally when I was looking at them it was after the fact talking about something that was two to three weeks old I didn't think she was going to remember that anyhow…
so I have noticed of different little snippits of things when I have conversations with her she has forgotten things moreso than I recall in the past so I am starting to see just a little bit of forgetfulness set in

(interviewer)Have you talked
You have two sisters

Yes

(interviewer)Have you talked to them about the dfp fieldtrial or anything about what's going on…

Not during the trial…
I mentioned it in conversations that we were working on it
And what the intent of the project was but I hadn't actually had a conversation with them since it started

(interviewer)Did they at the time express any kind of …
Did they have anything in particular to say about it or was it just in passing that you

Well, actually, yes, both of them expressed some interest
One of my sisters is more computer literate than the other
The one who was not so computer literate would probably be content to see the icons around the picture and just know scale of 1 – 4 an activtiy thing and let that be the indicator to her as to whether or not she would accellerate or decelerate the rate she was calling mom
In the absence of this technology they my sisters have been calling my mom on fairly regular basis as they have for many years
The sister who is more involved with computers… she would probably look at some of the drill down data moreso and her job it could be something so that when she got to work she could pull up somethng on the internet and take a look at mom's health and look at the display and drilll down on a day that catches her interest and be something there or she may even choose to run it on a pc at home but I don't know if she looks at it so much at the house because her daughter is on all the time using the machine
Youknow how that works.

(interviewer)You live physically closest to your mother
And do you feel like you hav ethe respons..
I'm just trying to figure out how the dynamics work
Do you feel like you have the respoonsibility for watching after her and spreading the news or do you think that your other sisters are fairly wellplugged into what your mom is up to…
Do things pass through you and go to them
How does that work?

I'd say that they are fairly plugged into what mom;s doing just from their own conversations with her
I rarely find something out at mom's house and call my sisters about it
Generally I don't …

…(interview continued for 11 total pages)

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